



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

230 SOUTH DEARBORN ST.

CHICAGO, ILLINOIS 60604

JUN 29 1988

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Jeffrey L. Mausteller
Plant Environmental Manager
Plaskon Electronic Materials,
Incorporated
Subsidiary of Rohm and Haas Company
2829 Glendale Avenue
Toledo, Ohio 43614-2599

Re: Plaskon Electronic Materials,
Incorporated
Toledo, Ohio
OHD 094 803 904

Dear Mr. Mausteller:

The United States Environmental Protection Agency (U.S. EPA) is in receipt of your submittal entitled, "Hydrogeologic Assessment of the Plaskon Electronic Materials, Inc. Plant Site - Toledo, Ohio". Currently, a site management process entitled "Environmental Priorities Initiative" (EPI) is under way at the United States Environmental Protection Agency (U.S. EPA) to prioritize all RCRA facilities. The goal of the process is to direct the U.S. EPA's efforts regarding corrective action to those facilities with the greatest perceived risk to human health and the environment. At this time, the U.S. EPA is not pursuing new 3008(h) consent agreements for corrective action until the EPI is completed.

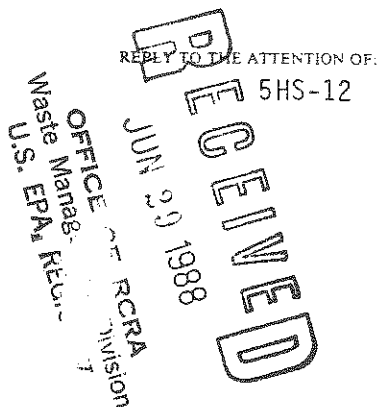
Nevertheless, the U.S. EPA strongly encourages facilities to take action necessary to protect human health and the environment on their own. The U.S. EPA reserves the authority to require corrective action under Section 3004(u), 3004(v), and 3008(h) of RCRA or other applicable authorities.

If you have any questions concerning this matter, please contact Kimberly Ogle at (312) 886-1478.

Sincerely yours,

Wm. E. Muno

William E. Muno, Acting Associate
Division Director
Office of RCRA



bcc: George Hamper, TPB-Ohio
 Don Heller, TPB-Ohio
 Karl Bremmer, TPB, Chief

SHS-12:Ogle:6/13/88

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| | TYP. | AUTH. | IL/IN TECH. ENF. SEC. | MI/WI TECH. ENF. SEC. | OH/MN TECH. ENF. SEC. | IL/MI/WI ENF. PROG. SECTION | IN/MN/OH ENF. PROG. SECTION | RCRA ENF. BR. CHIEF | O.R. A.D.D. | WMD DIR |
|---------------|---------------|---------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------|------------|
| INIT. DATE | LL 6/15/88 | KD 6/17/88 | | | CJL 6/17/88 | | | SKS 6-27-88 | WEM 6-28-88 | |



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PLASKON ELECTRONIC MATERIALS, INC.

Subsidiary of Rohm and Haas Company

May 16, 1988

RECEIVED

MAY 23 1988

U. S. EPA, REGION V
SWB - FMS

Mr. George Hamper, 5HS-13
U.S Environmental Protection Agency, Region 5
Waste Management Division
230 South Dearborn
Chicago, ILL 60604

Dear Mr. Hamper:

As part of a voluntary corporate-wide program Plaskon Electronic Materials, Inc., a subsidiary of the Rohm and Haas Company, conducted a hydrogeological assessment of our Toledo, Ohio plant site. No threat to human health or the environment was found to exist. Three small areas of soil/groundwater contamination were found, all located well within the plant boundaries. Plans to remove a non-aqueous phase floating layer composed primarily of phthalate esters are being developed. Study of the remaining two areas will be completed soon. Plaskon will take whatever measures are necessary, if any, to assure that human health and the environment is protected. The only materials found leaving the site were low levels of phthalate esters that infiltrated into leaky storm sewers. The Ohio EPA and EPA Region V were previously informed of this under our NPDES permit. Repair of the storm sewers has been initiated.

We are sending you a copy of the study report for your information. We plan to share the study results with our employees and local officials in the next week or two. We will send you copies of any follow-up work we perform. Please call me at (419) 389-5664 if you have any questions.

Sincerely,

Jeffrey L. Mausteller
Plant Environmental Manager

JLM:cah

cc: Mr. Maury Walsh, Ohio EPA /co



Hydrogeologic Assessment of the Plaskon Electronic Materials, Inc. Plant Site - Toledo, Ohio

Executive Summary



April 1988

EXECUTIVE SUMMARY

HYDROGEOLOGIC ASSESSMENT OF
PLASKON ELECTRONIC MATERIALS, INC. PLANT SITE
TOLEDO, OHIO

INTRODUCTION

A hydrogeologic assessment of the Plaskon Electronic Materials, Inc. plant site in Toledo, Ohio was conducted by Geraghty & Miller, Inc.. This assessment was conducted at the request of Rohm and Haas Company as part of a voluntary corporate-wide program to determine if past plant activities have impacted the soil or ground-water on or within the site. The assessment included: 1) reviewing past and present site activities to determine types of chemicals handled and areas of the site to be investigated; 2) the installation of 16 monitoring wells for the collection of ground-water quality data and the definition of site geology; and 3) chemical analysis of water samples collected from the wells, a storm sewer, an unnamed tributary to Delaware Creek, and during excavation of an underground gasoline tank. This executive summary presents an overview of the investigation and its conclusions.

CONCLUSIONS

Three areas within the plant site were found to have ground-water quality changes as a result of past plant activities. These

changes are confined to limited areas within the plant site and have not moved vertically downward to the dolomite aquifer.

Ground-water in the site vicinity is not used for a drinking water supply and therefore is not considered to be a health threat. If detected compounds were to move off-site through the dolomite aquifer, 33 to 133 years would be required and mixing and dispersion would reduce the concentrations about 100 to 10,000 times at the plant boundary. These concentrations would not pose a significant risk to human health. Because of the restricted usage of the site, ingestion of or dermal contact with soils is highly unlikely and is therefore not considered a health threat.

Focused investigations have been performed at two of the three identified areas noted above, and based on the data received from these investigations, a Focused Feasibility Study has been performed for one of these areas. The Feasibility Study recommends remediation involving containment of the NAPL presently on the plant property, and collection of the NAPL floating on the ground-water table. Investigations at the other two areas are presently being evaluated. A long term monitoring program is being developed by Plaskon in order to monitor and confirm that the conclusions reached in this site assessment are correct. Action has been initiated by Plaskon to ensure that no significant levels of organic compounds leave the site through the plant storm sewer.

BACKGROUND

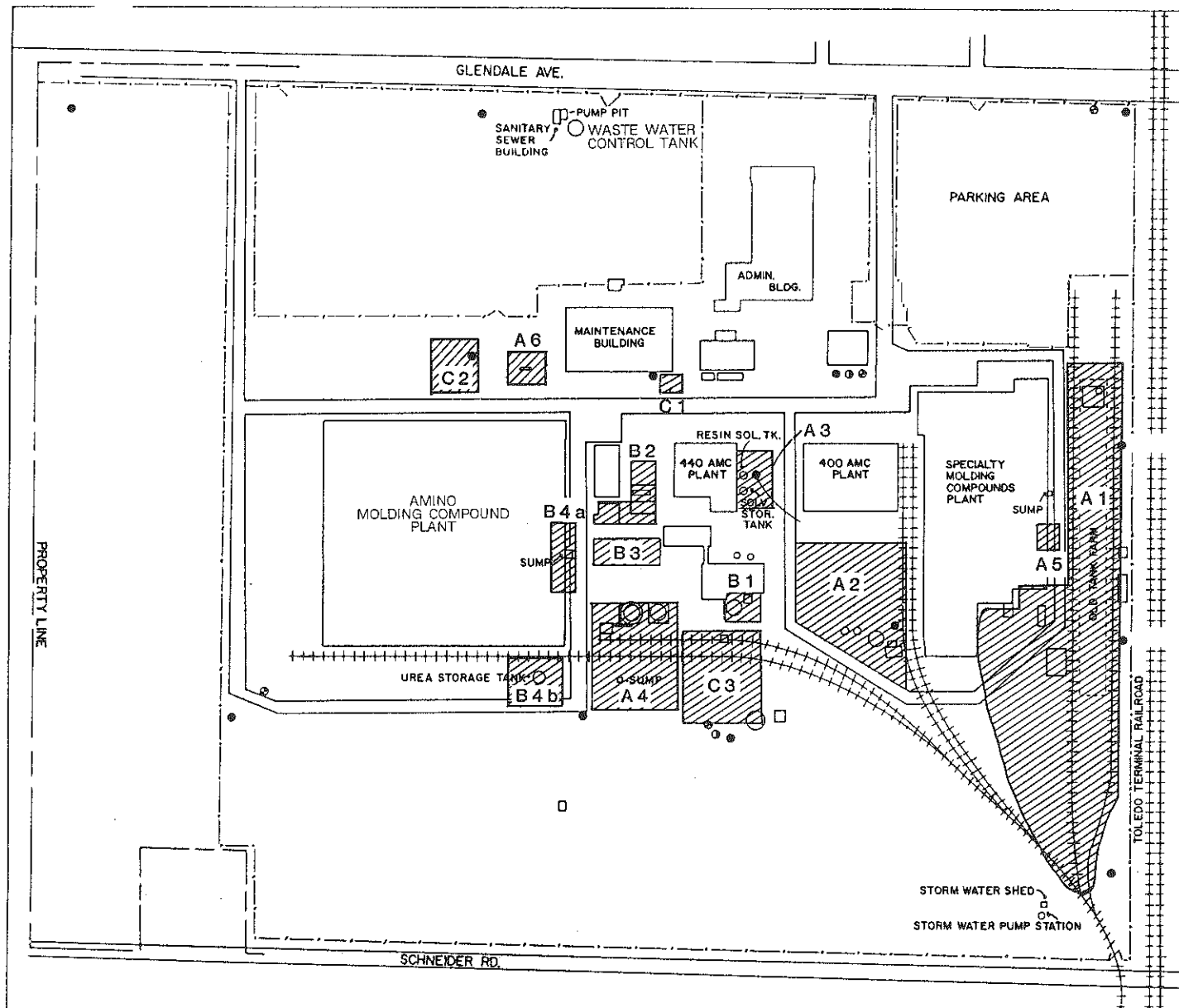
The plant is located on a 51-acre site, surrounded by open fields and parking lots, in a mixed industrial and residential area in southwest Toledo. Plasticizers, resins, and various molding compounds have been produced over a 40 year period during which the site was owned by four different companies. The site was owned by Libbey-Owens-Ford from 1947 to 1953, at which time it was purchased by Allied Chemical Corporation. In 1979, Hillside Capital Inc. acquired the facility from Allied Chemical. Rohm and Haas Company purchased the facility in 1984, and has owned and operated it since that time.

Although the manufacturing activities have been similar during the 40 year span, the production of specific compounds has changed. Numerous chemical compounds have been manufactured, stored, or handled at the site. Figure 1 illustrates the plant site and identifies the major past and present process chemical storage or use areas.

PROCESS CHEMICAL STORAGE

Liquid chemicals were used or temporarily stored on the site from the late 1940's until the mid-to-late 1970's, when production activities decreased significantly. The 6 major past and present liquid storage areas are:

- o East Tank Farm - the major bulk liquid storage area for the facility consisted of approximately 40 above ground storage tanks with capacities of between 6,000 gallons and 14,500 gallons. There was also a drum storage area



LEGEND

- 2" PVC WELL
- ◐ 4" PVC WELL
- PLANT WELL (INACTIVE)

A. MAJOR LIQUID STORAGE AREAS

- A1 EAST TANK FARM
- * A2 PLASTICIZER TANK FARM
- A3 POLYESTER RESIN TANKS
- * A4 FORMALDEHYDE/FUEL OIL TANKS
- * A5 DOWTHERM OIL TANK
- A6 DIESEL TANK
- * A7 UNDERGROUND GASOLINE TANK

B. OTHER CHEMICAL STORAGE AND USE AREAS

- * B1 BOILER WATER TREATMENT CHEMICALS
- * B2 WATER TREATMENT CHEMICALS
- * B3 CHLOROSILANE HYDROLYSIS
- * B4a UREA STORAGE
- * B4b UREA STORAGE

C. OTHER AREAS

- * C1 WASTE OIL SUMP
- * C2 WET-DUST COLLECTION SETTLING POND
- * C3 COAL STORAGE PILE

NOTE: * CHEMICAL STORAGE AREAS NO LONGER IN USE

FIGURE 1
LOCATION OF PAST/PRESENT AREAS
OF CHEMICAL STORAGE AND USE
PLASKON ELECTRONIC MATERIALS, INC.

located at the south end of the East Tank Farm where drums were stored primarily during the 1950s and 1960s.

- o Plasticizer Tank Farm - Phthalate plasticizers were stored in one 100,000-gallon tank and two 25,000-gallon above ground tanks in the south-central plant site areas.
- o Methylene chloride and polyester resin are stored in one 5,000-gallon above ground tank in the central plant area; another 5,000-gallon above ground tank that had previously also contained methylene chloride and polyester resin was removed in January, 1988.
- o Formaldehyde and fuel oil were stored until 1983 in a 200,000-gallon tank and a 50,000-gallon tank located in the southern plant area.
- o Dowtherm, a high-temperature heat transfer fluid, was stored on the eastern plant area until 1976. The tanks were removed in 1986.
- o A 3,000-gallon underground gasoline tank (removed in 1984) and a 300-gallon above ground diesel tank (currently in place) in the northern plant site area.

Other chemical or material storage and use areas investigated included the boiler water and treatment chemicals area, the water treatment chemicals area, the chlorosilane hydrolysis building, the urea storage area, a waste oil sump, the wet-dust collection and settling pond area, and a coal storage pile area (Figure 1).

Each of these areas described in this section was evaluated for potential environmental impact.

REGIONAL HYDROGEOLOGIC SETTING

The plant site is located in an area of little topographic variation; the elevation change across the Plaskon site is less than 5 feet. Swan Creek is about one-half mile to the north, the Maumee River is about one mile to the southeast, and Delaware Creek is located about one-quarter mile southeast. Storm water is collected by the storm sewer system and discharged to an unnamed tributary emptying into Delaware Creek.

Surface soils at the site, primarily silts and clays, have relatively low permeabilities resulting in poor site drainage. Ground-water level data for the site indicate that the water table is generally less than 10 feet below the land surface. However, ground water within the vicinity of the site is not used as a water supply due to the low permeability of the geologic materials described above. A series of northeast-southwest trending ground-water ridges and troughs, which represent barriers to horizontal ground-water flow, traverse the site.

The regional geology of the area consists of 0 to 120 feet of glacial till (sand, gravel, and clay) overlying a thick layer of dolomite and limestone bedrock. The glacial till does not readily yield water and is not used as a ground-water source. The glacial till under the plant site varies between 75 and 90 feet thick overlying the dolomite and limestone aquifer.

The dolomite and limestone aquifer underlying the site is between 350 to 800 feet thick. At one time the limestone aquifer was the primary source of ground water in the area. Five water supply wells, completed in the bedrock aquifer, were installed at the plant in 1947 to provide plant process water; use of the wells was discontinued in 1958 because of naturally present hydrogen sulfide in the water and because of regional water-level declines. The City of Toledo, as well as the Plaskon facility, currently receives its water from Lake Erie.

HYDROGEOLOGIC ASSESSMENT

INITIAL INVESTIGATIONS

Based upon the location of process chemical storage areas and other potential contaminant sources, a network of fourteen shallow (approximately 30 feet below land surface) monitoring wells were installed in the glacial till. Two deep (approximately 85 feet below land surface) monitoring wells were installed in the bedrock. Data collection included measurement of water levels, collection of ground-water samples and aquifer testing.

Ground-water flow in the shallow glacial till aquifer was found to be both downward toward the limestone and dolomite aquifer and laterally toward surface streams. The horizontal velocity within the glacial sediments ranges from 0.2 to 2 ft/year. The estimated velocity of ground-water in the dolomite is estimated to be about 35 ft/yr.

TABLE 1

PARAMETERS AND CONSTITUENTS ANALYZED IN WATER SAMPLES
PLASKON ELECTRONIC MATERIALS, INC.

FIRST SAMPLING ROUND - MARCH/APRIL 1986

| | |
|--------------------------------|------------------|
| pH | Chloride |
| Specific Conductance | Sulfate |
| Suspended Solids | Fluoride |
| Chemical Oxygen Demand (COD) | Phosphorus |
| Biological Oxygen Demand (BOD) | Ammonia-Nitrogen |
| Total Organic Carbon (TOC) | Nitrate-Nitrogen |
| Total Organic Halogens (TOX) | Iron |
| Oil and Grease | Manganese |
| Total Phenols (4-AAP) | Potassium |
| Foaming Agents (MBAS) | Sodium |
| 126 Priority Pollutants | Barium |
| Formaldehyde | |
| Styrene | |

SECOND SAMPLING ROUND - OCTOBER/NOVEMBER 1986

| | |
|--------------------------------------|------------------|
| Priority Pollutant Volatile Organics | Dissolved Solids |
| Priority Pollutant Phthalates | Chloride |
| Formaldehyde | Sulfate |
| Total Phenols (4-AAP) | Ammonia-Nitrogen |

- 1 - Analyses for 46 Base-Neutral Extractable Priority Pollutants were conducted on one water sample (first sampling round) and two free product samples from well GM-12 and sample from storm sewer (second sampling round).
- 2 - Sample collected from Delaware Creek (second sampling round) was not analyzed for volatile organic compounds.

Water Quality

Water samples were collected for chemical analysis from the monitoring wells, three deep Plant wells, the on-site storm sewer, the unnamed tributary to Delaware Creek, the plant municipal supply and an open excavation (standing water) where an underground gasoline tank was removed. The initial samples were analyzed for 126 priority pollutant chemicals, several indicator compounds and additional constituents (Table 1) based on information indicating their use on-site. The second set of samples was analyzed for selected constituents based on results of the first set of samples.

Initial ground-water and soil investigations indicated that chemicals used at the site could be detected in the ground water in some areas. There are three specific areas affected:

- o The plasticizer tank farm area: A thin non-aqueous phase liquid (NAPL) floating layer composed primarily of bis (2-ethylhexyl) phthalate, with smaller amounts of polynuclear aromatic hydrocarbons and volatile organic compounds was found.
- o The methylene chloride tank farm area: methylene chloride concentrations in ground water of 3.2 parts per million (ppm) and 9.7 ppm, as well as relatively minor concentrations of other volatiles were detected.
- o The wet-dust settling pond area: Ammonia-nitrogen concentrations of 996 ppm and 1,130 ppm, and

formaldehyde concentrations of 26.3 ppm and 40.8 ppm were detected.

Relatively insignificant changes in ground-water quality from what might be expected in background ground-water quality samples were detected in some of the other ground-water samples. Organic compounds were also detected in the storm sewer sample and the sample collected from the unnamed tributary to Delaware Creek. Vinyl chloride was detected in ground-water samples obtained from monitoring well GM-6 (2.3 and 4.5 ppb). Based on site characteristics, however, vinyl chloride is most likely present because of the PVC well construction material and not as a result of Plant activities.

PHASE II INVESTIGATIONS

Because of the chemicals found in the water samples, additional soil borings were made in the vicinity of the plasticizer tank farm and the methylene chloride tank, and two sumps in the central plant area were inspected to determine the horizontal and vertical extent of methylene chloride and phthalate in the soils. Additional investigations are planned in the vicinity of the wet dust settling pond, where concentrations of ammonia-nitrogen were found.

Plasticizer Tank Farm Area

Fourteen soil borings were drilled in the vicinity of the plasticizer tank farm with one of the borings completed as a shallow monitoring well. NAPL was found in the soils as a clear

to light brown oily liquid containing small dark-brown globules. The liquid and globules were observed to be floating on top of the water table with some of the globules suspended near the top of the water column. The average thickness of the NAPL was estimated to be 0.2 inches. Above background concentrations of bis (2-ethylhexyl) phthalate and di-n-octyl phthalate were limited to 10 feet below ground surface.

The NAPL has migrated approximately 150 feet southeast (downgradient) of the phthalate Tank Farm. The affected area is approximately 0.64 acres.

Methylene Chloride Tank Farm Area

Five soil borings were drilled in the vicinity of the methylene chloride tank. The highest detected soil sample concentrations were less than 0.25 mg/kg, indicating little residual methylene chloride remaining in the soils.

Other Areas Investigated

A sump at the Molding Compound Plant was investigated. Based on the observed water level within the sumps relative to ground-water elevations within the immediate vicinity of the sumps, the potential exists for methylene chloride in ground water (currently confined to a relatively limited area around the 440 AMC Plant) to eventually be intercepted by the french drain system that encircles the Molding Compound Plant and ultimately transported off-site via the sumps.

TRANSPORT AND ENVIRONMENTAL FATE OF DETECTED CONSTITUENTS

To assess potential environmental impact resulting from chemicals found in the soils and ground-water, it is necessary to identify those constituents detected at concentrations approaching or exceeding existing water quality criteria; determine potential exposure routes; estimate the transport rate and fate of the various constituents within the ground-water system; and estimate at what time and concentrations various constituents may reach a downgradient receptor or discharge point.

Water Quality Criteria

Regulatory standards for methylene chloride are scheduled to be established by the USEPA (U.S. Environmental Protection Agency) in the near future; however, the USEPA Lifetime Health Advisory for methylene chloride is 1,750 ug/l. Although no primary drinking water criteria exist for formaldehyde and ammonia-nitrogen, EPA has suggested an ambient goal of 41.4 ug/l (0.041 mg/l) for formaldehyde and the World Health Organization has established a recommended drinking water standard of 0.5 mg/l for unionized ammonia.

Relative Transport Rates of Constituents

The general mobility and fate of the primary constituents at the Plaskon site are outlined below:

- o Bis (2-ethylhexyl) phthalate and polynuclear aromatic hydrocarbons (PNAs) are relatively immobile in ground water. They generally will move tens to hundreds of times slower than ground water and are highly adsorbed to soil particles. Their maximum rate of movement appears to be 4 feet per year.
- o Methylene chloride has a high solubility, moves readily with ground water, and is highly volatile.
- o Formaldehyde is mobile in ground water and biodegrades rapidly.
- o The ammonium ion in ammonia-nitrogen adsorbs to soils and is transported slowly in ground water. Under oxidizing conditions and high organic soil content, NH_4^+ may convert to nitrate (NO_3), which is quite mobile in ground water.

Potential Migration Pathways and Estimated Rate of Transport

The investigations of the Plasticizer Tank Farm Area indicate the direction of NAPL movement is southeast, at an estimated maximum transport rate of 4 feet per year.

Ground water containing levels of chemical constituents above background ground-water samples is primarily confined to the main manufacturing area. Based on ground-water quality data, chemical constituents have not migrated vertically to the dolomite aquifer or horizontally to the site boundaries.

Although no evidence of off-site transport via ground water was found, an evaluation of theoretical off-site transport was conducted. Potential transport of these chemicals off the Plaskon site may occur as NAPL floating on the water table, dissolved chemicals in the ground water, movement of shallow ground-water by french drains and leaky storm sewers to Delaware Creek, or erosion and transport of surface soils.

Erosion and transport of surface soils is unlikely except during construction activities. Design and implementation of remedial measures to contain, control or remove the NAPL layer are in progress and will control NAPL movement and potential discharge through the storm drains. The only remaining method whereby constituents could theoretically be transported off-site is by movement of dissolved compounds within the ground-water system. If a theoretical receptor is assumed to exist at the site boundary, 800 feet from the central plant areas, then the rate of transport to this receptor and the dilution occurring along the transport pathway can be calculated.

The most rapid pathway for a chemical compound to move via ground water would be vertically downward to the dolomite aquifer and then laterally within the dolomite. Although this is not the true physical system present at the site it is assumed here to provide a worst case bound on the minimum time necessary for chemical transport to the plant boundaries. Vertical ground-water flow downward through the 70 feet of glacial till is estimated to be at a rate of 0.7 to 7 feet per year, or 10 to 100 years to reach the dolomite. Horizontal flow within the dolomite is estimated to be 35 feet per year or approximately 23 years to travel 800 feet. Minimum travel time for a non-reactive, non-retarded constituent from the plant site surface to the plant

boundary via ground-water is then estimated to be 33 to 133 years. Dilution as a result of mechanical mixing, dispersion, and adsorption would reduce the initial concentration by a factor of 160 to 5,000 at the plant boundary (800 feet); predicted constituent concentrations are shown below:

| <u>Constituent</u> | <u>Highest Detected Concentration</u> | <u>Estimated Range In Future Concentrations at Site Boundaries</u> |
|--------------------------------|---|--|
| Methylene Chloride | 9.7 ppm | 1.9 - 61 ppb |
| Un-ionized Ammonia-nitrogen | 11.3 ppm | 2.3 - 71 ppb |
| Formaldehyde | 40.8 ppm | 8.2 - 260 ppb |

It is important to note that the nearest potential ground-water receptor (private well), however, is located 1.8 miles from the Plaskon facility. Potential future constituent concentrations at this receptor would therefore be significantly lower than those shown above.

PLASKON103/EXEC.SUM



Hydrogeologic Assessment of the Plaskon Electronic Materials, Inc. Plant Site - Toledo, Ohio

Volume 1



March 1988

HYDROGEOLOGIC ASSESSMENT OF
PLASKON ELECTRONIC MATERIALS, INC PLANT SITE
TOLEDO, OHIO

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PLASKON ELECTRONIC MATERIALS, INC.

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PLASKON ELECTRONIC MATERIALS, INC.

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PLASKON ELECTRONIC MATERIALS, INC.

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PLASKON ELECTRONIC MATERIALS, INC.

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MARCH 17, 1988
PLASKON ELECTRONIC MATERIALS, INC.

SUMMARY

At the request of Rohm & Haas Company, as part of a voluntary corporate wide program, Geraghty & Miller, Inc. has conducted a hydrogeologic assessment of the Plaskon Electronic Materials, Inc. site in Toledo, Ohio. The hydrogeologic assessment included:

- o review of past and present site activities;
- o determination of the site hydrogeology, including the directions and rates of ground water movement,
- o installation of sixteen monitoring wells for the collection of ground-water samples, measurement of water levels, and definition of site geology,
- o chemical analyses of water samples collected from the monitor wells, three unused plant water wells, an underground gasoline tank excavation, the storm sewer, and an unnamed tributary to Delaware Creek, and
- o assessment of the impact of past site activities on ground-water quality.

Site activities, of specific interest to this investigation included a former wet-dust settling pond where urea-formaldehyde and melamine-formaldehyde wastes were disposed, and four major liquid storage areas: (1) the East Tank Farm, (2) Plasticizer

MARCH 17, 1988
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Tank Farm, (3) Polyester Resin and Methylene Chloride Tanks, and (4) Formaldehyde and Fuel Oil Tanks. There is evidence of spills due to routine storage and handling have occurred in all four storage areas. Other former and present potential sources of chemical release include underground gasoline tanks, small fuel oil storage tanks, water treatment chemicals, a waste oil sump, a coal storage pile, and other minor chemical use areas.

The Plaskon Site is underlain by about 65 feet of unconsolidated, low permeability glacial sediments (silt and clay), which overlie a thick sequence of dolomite and limestone bedrock. The water table generally ranges between 1.5 and 7.5 feet below ground surface and, because of large scale pumping of the dolomite aquifer in the past, the potentiometric surface of the dolomite aquifer is about 60 feet below the land surface. Ground water flow in the glacial sediments is locally controlled by streams and surface topography although there is a strong downward component of ground water flow through the glacial sediments to the dolomite. Ground-water flow through the dolomite is predominantly lateral and controlled by major surface streams. Past over pumpage of the dolomite aquifer has resulted in regional drawdowns and long term declines in the potentiometric surface. Ground-water flow rates within the glacial sediments are estimated to be between two and twenty feet per year. Flow through the dolomite aquifer is estimated at 35 feet per year. The closest documented ground-water user (from the dolomite aquifer) to the Plaskon Site is approximately 1.8 miles toward the northwest. Locally, on the Plaskon Site, ground-water flow directions are influenced by a system of french drains and storm sewers that flow to a storm sewer system which discharges to the unnamed tributary to Delaware Creek.

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Sixteen monitoring wells were installed on the Plaskon Site. Water samples were collected from all wells and analyzed for the 126 priority pollutants as well as additional compounds that were previously used on the site and a number of indicator parameters. Several chemical constituents were detected above background concentrations in three wells. The compounds detected were ammonia-nitrogen and formaldehyde in well GM-4, the site of the former waste-settling pond; methylene chloride in well GM-6, where a methylene chloride spill reportedly occurred; and a non-aqueous phase liquid predominantly composed of bis (2-ethylhexyl) phthalate, in well GM-12, near a phthalate plasticizer tank car unloading station. Other wells showed trace levels of compounds used on-site.

Wells located at the boundaries of the site showed no elevated concentrations of inorganic or organic compounds. A sample taken from the storm sewer system contained detectable concentrations of phthalate esters and polynuclear aromatic hydrocarbons. Two samples taken from the unnamed tributary to Delaware Creek revealed elevated concentrations of bis (2-ethylhexyl) phthalate in the downstream sample as opposed to the upstream sample.

The areal and vertical extent of ground-water quality changes related to site activities is confined to the main manufacturing/buildings area. The vertical extent of impact at GM-4, GM-6 and GM-12 apparently does not extend to the dolomite aquifer.

Although no evidence of off-site transport was found during the investigation, a theoretical evaluation of contaminant transport off-site was conducted. Potential transport off the Plaskon site may occur in the following ways:

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- o Movement of the non-aqueous phase liquid in the vicinity of GM-12 as a separate layer floating on top of the water table in a downgradient direction (to the south);
- o Movement of chemical constituents dissolved in the ground water downward through the glacial sediments to the dolomite aquifer;
- o Movement of shallow ground water to french drains and possibly leaky sewers and ultimately to Delaware Creek; and
- o Erosion of contaminated surface soils and sediment transport off-site.

Because ground water is not used for a drinking water supply in the vicinity of the Plaskon site, there is no ^{immediate} health threat from the contaminated ground water. Based on the preliminary risk assessment performed as part of this study, even the drinking of ground water at the site boundary poses only a minimal risk even under the worst-case assumption of conditions. If compounds detected at the Plaskon site were to move off-site through the dolomite aquifer, mixing and dispersion would reduce the concentrations by 10,000 times at a distance of one mile from the site.

The bis (2-ethylhexyl) phthalate and the polynuclear aromatics are relatively insoluble and immobile in ground water, the occurrence of free product floating on the water table at shallow

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depths poses a potential on-site exposure opportunity during any future excavation or construction activities.

Recommendations for further investigation include: evaluation of remedial alternatives for removal of the non-aqueous phase liquid in the vicinity of GM-12 (this work is already in progress); further delineation of the impacted area in the vicinity of well GM-4 (work in this area is also in progress), periodic sampling of all monitor wells; and inventory and periodic sampling of sanitary and storm sewers.

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1.0 INTRODUCTION

This section presents the background and scope of this hydrogeologic assessment and discusses the setting and history of the site.

1.1. BACKGROUND

In November 1985, Plaskon Electronic Materials, Inc., as part of a voluntary corporate wide program, requested Geraghty & Miller, Inc. (G&M) to conduct a hydrogeologic investigation at the Plaskon Electronic Materials, Inc. plant site in Toledo, Ohio. The plant is located on a 51-acre site in a mixed industrial and residential area in southwest Toledo, about one mile west of the Maumee River and about 10 miles southwest of the Maumee Bay of Lake Erie (Figure 1). From 1947 until 1979, the site was used for the production of plasticizers, resins, and various molding compounds. Since 1979 only the molding compounds have been produced.

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The primary objective of the hydrogeologic investigation was to determine if past or current plant operations had resulted in adverse environmental impact to soil or ground water at the site, and if so, to determine if ground water or surface water leaving the site was affected.

1.2. SCOPE OF INVESTIGATIONS

The investigations were conducted in two phases, a site-wide hydrogeologic assessment, followed by detailed hydrogeologic assessments aimed at further characterizing soil and ground-water conditions at specific locations within the facility.

The first phase of investigations included:

- o Compilation and analysis of existing hydrogeologic and site history information.

- o Design and installation of a monitoring-well network to provide water-quality and water-level data in both the shallow ground-water system and the bedrock aquifer and to obtain site-specific geologic information.

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- o Completion of in-situ hydraulic conductivity tests on shallow monitoring wells to determine hydraulic characteristics of the shallow ground-water system. Analysis of data from pumping tests on five deep plant water-supply wells conducted by the U.S Geological Survey in 1947 to determine hydraulic characteristics of the bedrock aquifer.
- o Collection and chemical analysis of two rounds of water samples from monitoring wells (April 1986 and October-November 1986).
- o Assessment of hydrogeologic and water quality data and identification of areas for more detailed investigation.

The second phase of investigations included:

- o Performance of soil borings in the vicinity of the plasticizer tank farm.
- o Installation of monitoring well GM-15, in order to monitor ground-water quality down-gradient of the plasticizer tank farm.

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- o Performance of soil borings in the vicinity of the methylene chloride tank in Area 3.
- o Investigation of ground-water flow to the french drain and associated collection sump at the molding compound plant.

1.3. SITE SETTING

Toledo is situated on a Pleistocene lake plain that slopes gently to the north and east towards Maumee Bay and Lake Erie at about 4 to 6 feet/mile. This plain is incised by the channels of the Maumee River, Ottawa River, Swan Creek and other small drainages. Surficial soils, consisting primarily of silt and clay, were derived from fine-grained glacial deposits and generally have low permeabilities. Surface and subsurface drainage is poor because of the combination of flat topography and low permeability soils. The water table generally is less than 10 feet below the land surface. The average annual precipitation is 32 inches.

The Plaskon site is located on a flat plain between Swan Creek, about one-half mile to the north, and the Maumee River, about one

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mile to the southeast (Figure 1). Delaware Creek, a small tributary to the Maumee River, is located about one-quarter mile southeast of the plant site. Storm water from the plant site is discharged into an unnamed tributary of Delaware Creek that originates immediately south of the plant. Topographic relief at the plant site is less than 5 feet. Depths to ground water on the plant site generally range from 1 to 7 feet below the land surface. The site is located in a mixed industrial and residential area; however, the plant site is surrounded primarily by open fields and parking lots.

1.4. SITE HISTORY

1.4.1. MANUFACTURING ACTIVITIES

Plasticizers, polyester resins, and various molding compounds have been manufactured at the Plaskon site for the last 40 years. Production first began at the site in 1947, when the plant was owned by the Libbey-Owens-Ford Glass Company. Allied Chemical Corporation owned the plant from 1953 until 1979, when it was purchased by Hillside Capital, Inc. Rohm & Haas Company purchased the plant in 1984. The plant is operated by Plaskon Electronic Materials, Inc., a subsidiary of Rohm & Haas Company.

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Manufacturing activities have generally been the same under all owners; however, production of specific compounds and chemicals used has changed over the years. Table 1 summarizes the products manufactured and principal raw materials used in the four manufacturing plants on-site: the Amino Molding Compound Plant, the 440 AMC Plant, the 400 Alkyd Molding Compound (AMC) Plant, and the Specialty Molding Compound Plant (see Figure 2). Production of most compounds was sharply reduced between 1975 and 1978. Urea-formaldehyde molding compound was produced until 1983. Currently, 446 Polyester is produced in the 440 AMC Plant and Epoxy Molding Compound is produced in the Specialty Molding Compound Plant and the Amino Molding Compound Plant.

1.4.2. PLANT SITE PRODUCTION AND STORAGE AREAS

One of the goals of the Phase One investigation was to determine if past or present site activities had released significant quantities of chemicals onto the soils or into the ground water at the plant site. The phase one investigations therefore began by locating and identifying the primary production and storage areas on site and the compounds used or stored within these areas. The Phase One investigation focused on areas where

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maximum impact would be expected to have occurred. No assumption was made, nor was there reason to assume that the plant site actually possessed "major" environmental problems. It was simply more direct to begin where major spills might exist and work outward to expected background conditions at the site boundaries.

Numerous chemical compounds have been manufactured, stored, or handled at the site. Officials and personnel of Plaskon Electronic Materials, Inc. and Rohm and Haas Co. provided information describing the use and storage of chemicals at the site based primarily on their knowledge of past and present site activities. This information is summarized in Figure 3. Areas of interest identified for the Phase One investigation are:

- o Major liquid storage areas
- o Other chemical storage and use areas
- o Other miscellaneous areas

1.4.2.1. Major Storage Areas

Large quantities of liquid chemicals were stored on the site from the late 1940's until the mid-to-late 1970's, when production

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activities decreased. The major storage areas, A1 to A6, are shown in Figure 3 and are discussed below:

Area A1 - East Tank Farm - The East Tank Farm, which was the major bulk liquid storage area for the facility in the past, once contained about 40 above-ground storage tanks with capacities of between 6,000 gallons and 14,500 gallons. Chemicals were loaded into the storage tanks from railroad tank cars. Most piping from the storage tanks to areas of use was above ground and available for inspection and rapid detection of any leaks or spills. Although the use and storage of most chemicals was phased out during the mid-1970's, some chemicals were left in the tanks until the tanks were removed in the early 1980's. The tank area was surrounded by 18-inch high earthen dikes on the north, south and east sides of the tank farm.

Two tanks containing methylene chloride were within a secondary containment structure. The floor and walls of this secondary containment structure were constructed of reinforced concrete. No major spills or tank leaks are documented although small spills may have occurred during loading operations and/or from leaky pump seals.

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Methylene chloride is the only chemical currently stored in this area. It is stored at the northern end of the tank farm in a 10,000 gallon tank that is within the concrete secondary containment structure previously described. During 1985, approximately 1,800 gallons of methylene chloride were found to be apparently unaccounted for during routine inventory procedures. The loss may have occurred from volatilization through the tank vent, from leaky pump seals, from small spills during loading or from inventory error.

A drum storage area is located at the south end of Area A1, where drums were stored primarily during the 1950's and 1960's. Some drums contained polyester resins, phenolics, and plasticizers. A small number of drums are currently stored in this area, some of which contain acetone and waste oil.

Area A2 - Plasticizer Tank Farm - Phthalate plasticizers were stored in one 100,000 gallon tank and two 25,000 gallon above-ground tanks. All three tanks remain at the site, but are emptied and decommissioned. The process of decommissioning the tanks took place in 1983-84, under the direction of a private consultant, William M. Auberlepe.

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The Ohio EPA then inspected the decommissioned tanks, and issued their approval in a March 12, 1984 letter to Plaskon Electronic Materials, Inc.

Releases of phthalate plasticizers in this area are reported to have occurred during loading and unloading operations. Employees indicate that during the 1950's a well-point was installed adjacent to the north side of the 100,000 gallon above ground tank, in an attempt to remove the spilled chemicals from the subsurface. A non-aqueous phase liquid (NAPL), or free product layer, currently occurs on the water table in this area.

Area A3 - Methylene Chloride and Polyester Resin Tanks -

Two 5,000 gallon tanks adjacent to the 440 AMC Plant building were used to store methylene chloride and polyester resin. The southernmost tank is out of service, and was decommissioned along with the Area A2 tanks described above. A release of methylene chloride resin mixture is reported to have occurred during loading of a tank between 12 and 15 years ago. Minor releases during loading operations are also reported to have occurred.

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Area A4 - Formaldehyde and Fuel Oil Tanks - Formaldehyde and fuel oil were stored in a 200,000 gallon tank and a 50,000 gallon tank, respectively, until 1983. A small amount of heavy fuel oil still remains in the fuel oil tank. The fuel oil tank has a 4-foot high, double-walled concrete containment structure.

Area A5 - Dowtherm Oil Tank - A 5,000 gallon underground storage tank for Dowtherm Oil, a high-temperature heat transfer fluid, was last used in 1976 and removed in 1986.

Area A6 - Underground Gasoline Tank and Above-ground Diesel Tank - A 3,000 gallon underground gasoline tank was last used in 1984 and was removed in 1986. When the tank was removed, no visible signs of leakage were present. Soil samples collected from the excavation did not appear to be contaminated with gasoline. A small amount of gasoline observed floating on standing water in the excavation is believed to have been released when the piping was cut. The above-ground 150 gallon diesel tank is still in use.

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1.4.2.2. Other Chemical Storage and Use Areas

Other chemical storage and use areas include:

- o Area B1 - Boiler Water and Treatment Chemicals
- o Area B2 - Water Treatment Chemicals
- o Area B3 - Chlorosilane Hydrolysis Building
- o Area B4 - Urea Storage (B4-a and B4-b)

Detailed information regarding chemical use or possible releases of chemicals in these areas is not available. Plant personnel report that minor spills of sulfuric and hydrochloric acid may have occurred near the Chlorosilane Hydrolysis Building (Area B3) but no evidence was present to indicate any impacts in the area. Urea was stored in dry form as pellets in areas B4-a and B4-b; therefore, any spills or releases in this area would have been as particulates.

1.4.2.3. Other Areas of Interest

Other site activities that may have had some impact on the site include:

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- o Area C1 - Waste Oil Sump - The exact age of the concrete-lined waste oil sump is not known. The sump was used to collect and store waste oil that was subsequently removed and disposed of off-site.
- o Area C2 - Wet-Dust Collection Settling Pond - The wet-dust collection and settling pond was used from 1950 to 1965. The pond retained the dust collector effluent from the manufacture of urea-formaldehyde and melamine-formaldehyde molding compounds as well as other products to settle out solids and separate oils. Solids were collected and trucked off-site to a state approved landfill at least once a year by a contractor. Oils were skimmed off for recovery. The pond area is now backfilled and grass covered.
- o Area C3 - Coal Storage Pile - Coal used for steam generation was last stored in this area in the early 1980's.

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1.4.3. SEWER SYSTEMS

1.4.3.1. Storm Sewers

The on-site storm sewer system receives water from roof drains, sumps, parking areas and fields, and discharges to an unnamed tributary of Delaware Creek, southeast of the plant site (Figure 1). Shallow ground water collected from a series of french drains and sumps, installed to control ground water levels adjacent to plant building foundations, and non-contact process cooling waters also are discharged to the storm sewer.

The storm sewer discharge is permitted by the Ohio Environmental Protection Agency under the National Pollutant Discharge Elimination System (NPDES) program. As part of the permit requirements, the discharge is sampled monthly by an automatic peristaltic-pump sampler and analyzed for pH, total suspended solids, and oil and grease. Prior to July 1985, the discharge was also analyzed for chemical oxygen demand (COD) and ammonia-nitrogen ($\text{NH}_3\text{-N}$). The sampler is located in the storm water shed in the southeast corner of the site (Figure 2). The average reported discharge (during the period January, 1986 - March, 1987) of the storm sewer is 90,440 gallons per day.

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1.4.3.2. Sanitary Sewers

Manufacturing and sanitary wastes from the plant are discharged to the Toledo Municipal Sewer Utility, via a sanitary sewer which exits the site at the north end of the facility along Glendale Avenue. The suspended solids and oil and grease content and pH of the wastewater are monitored semi-weekly. A 20,000 gallon holding tank is connected to the sanitary sewer discharge line where in-plant spills or inadvertent releases can be contained without releasing them to the sanitary sewer system.

1.4.4. PLANT WATER WELLS

Five water-supply wells ranging in depth from 520 to 533 feet were installed at the site in 1947 to provide water for plant processes. Each well, when it was used, withdrew water from the dolomite aquifer at rates between 250 and 300 gallons per minute. Over development and over use of the dolomite aquifer by municipalities, industries and agriculture activities in the region resulted in significant declines in the water levels within the aquifer during the 1940's and 1950's. The City of Toledo changed to Lake Erie as a water supply source during the

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1950's. This change by the city created an alternate water supply source for industry in Toledo. Use of the wells was discontinued by Plaskon in about 1958 because the presence of naturally occurring hydrogen sulfide in ground water coupled with the large regional water-level declines made use of the on-site supply wells less economical than use of the municipal water supply.

Locations of 4 of the 5 plant wells are shown in Figure 2. Well PW-2 could not be located and apparently has been abandoned. Wells PW-1, PW-3, and PW-5 were used as monitoring wells during the present investigation.

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2.0 FIELD INVESTIGATIONS

This section presents the sequence of field investigation activities and describes the methodology for installation of monitoring wells and performance of soil borings, soil sampling, hydraulic conductivity testing, water level measurements, water sampling, and other investigations.

2.1. MONITOR WELL INSTALLATION AND SOIL BORINGS

Fifteen shallow monitor wells (GM-1 through GM-15) were installed in the unconsolidated glacial sediments to depths ranging from 20 to 30 feet below land surface (Figure 2 and Table 2). Well GM-11S was abandoned shortly after its installation because of interference with underground electrical lines. Two deeper monitor wells, GM-7D and GM-11D, were installed in the upper 15 feet and 6 feet of the dolomite bedrock at depths of 84 feet and 86 feet, respectively. With the exception of GM-15, well locations and completion depths were based on the initial evaluation of the site hydrogeology and identified areas of interest. Well GM-15 was installed during the second phase of

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field activities, in order to further define ground-water quality downgradient of the plasticizer tank farm. Well GM-15 was installed in borehole TB-12K (details regarding boreholes TB-12A to TB-12N are described below); borehole location TB-12K was selected because it is directly downgradient (toward the south-southeast) of the plasticizer tank farm.

All boreholes in which the shallow wells were installed were drilled using conventional hollow-stem auger methods. Split-spoon samples of the sediments were collected from each borehole at intervals of five feet or less and were described in the field by an on-site hydrogeologist, in accordance with American Society of Testing and Materials (ASTM) method 1586. The procedures used for subsequent collection of ground-water samples from monitoring wells are discussed in Appendix C. Sample description logs for all boreholes are included in Appendix A. All drilling equipment was steam-cleaned prior to drilling of each borehole. Split-spoon samplers were washed with laboratory detergent and rinsed with distilled water prior to collection of each soil sample from the borehole.

Most shallow monitoring wells were installed in the open boreholes after removal of the hollow-stem augers. Where collapsing soil conditions were encountered (GM-1, GM-2, GM-3 and

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GM-4), the borehole was redrilled to a larger diameter and the well was installed inside the hollow-stem augers. Each shallow monitoring well assembly consisted of 2-inch diameter, flush-jointed, schedule-40 PVC (polyvinyl chloride) casing and a 10-foot section of 0.010-slot, flush-jointed, schedule-40 PVC screen. All casings and screens were steam-cleaned prior to installation. After the well assembly was placed in the borehole, a clean silica sand pack was placed in the annular space around the screen and casing to within approximately 7 feet of the land surface; and a 1 to 3-foot seal of granular or pelletized bentonite was placed above the sand pack. The remainder of the borehole annulus was filled with a bentonite-amended cement grout (approximately 10 percent by volume bentonite); a 5-inch diameter metal protective casing with a hinged cap and lock was installed over each well and seated into the grout.

The deep monitoring wells were constructed by first installing a 4-inch diameter, flush-jointed, schedule-40 PVC casing to the top of the bedrock and placing a bentonite-amended cement grout in the annular space using a tremie pipe. Casing for well GM-7D was installed through the hollow-stem auger and casing for well GM-11D was installed in the open borehole. After allowing the cement grout to set for approximately six days, mud-rotary

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drilling methods were used inside the 4-inch casing to drill into the dolomite bedrock. Well GM-7D was completed with a 2.5-inch diameter, 15-foot open borehole and well GM-11D was completed with a 3.75-inch diameter, 6-foot open borehole. A 6-inch diameter protective steel casing with hinged lid and lock was installed (seated into cement grout) over the 4-inch casing. Well construction logs for all wells are included in Appendix A.

The shallow monitoring wells were initially developed by removing water from the well using a bottom-filling PVC bailer until the well yielded relatively sediment-free water. To avoid cross-contamination of other wells with the PVC bailer, well GM-12, which contained NAPL, was not initially developed during installation, but was developed during the first sampling period. The two deep monitoring wells were developed by first removing several well volumes of water using a 3-inch diameter, 6-foot long, steel bailer, then by pumping with a Grundfos submersible pump. The PVC bailer and the submersible pump were cleaned with laboratory detergent and rinsed with distilled water prior to the development of each well.

As indicated in Section 1.2, the second phase of field investigations included performance of 14 soil borings (TB-12A to TB-12N) in the vicinity of the plasticizer tank farm. Soil

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samples were collected from all soil borings, at intervals that ranged from continuous collection to 2 foot intervals. One soil sample from each of 5 selected soil borings (for a total of 5 samples) were submitted for laboratory analysis. The soil borings from which samples were collected were chosen in order to obtain a representative areal sampling distribution of the plasticizer tank farm area. All 5 soil samples were analyzed for base/neutral extractable organics and phthalates. Although no volatile compounds are currently stored in this vicinity, 2 of the soil samples were analyzed for VOCs.

All soil borings in the vicinity of the plasticizer tank farm were drilled using 3-1/4" hollow stem augers, with no drilling fluids introduced into any of the boreholes. After drilling of the soil borings was completed, the open boreholes were monitored for the presence of NAPL (as described in Section 4.1.5), and subsequently closed with a cement-bentonite mixture upon completion of field activities. Boring log information for soil borings TB-12A to TB-12N is presented in Appendix A.

The second phase of field activities also included performance of soil borings in the vicinity of the methylene chloride tank in Area 3, obtaining soil samples from these borings and conducting field observations on liquid samples from the subsequent open

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boreholes. A total of 5 soil borings were drilled in the vicinity of this methylene chloride tank. Soil samples were collected using a split-spoon soil sampler and visually classified at intervals ranging from 1.5 to 3 feet. All soil samples were prescreened in the field using an HNu organic vapor analyzer. A total of 8 soil samples (2 from each of 4 borings) were submitted for laboratory analysis for methylene chloride.

All soil borings in the vicinity of the methylene chloride tank in Area 3 were drilled using 3-1/4" hollow stem augers, with no drilling fluids introduced into any of the boreholes. Upon completion of drilling, liquid samples were obtained from the boreholes for field observations (i.e., color, odor, HNu scan, etc.); these observations are summarized in Appendix A. At the completion of field activities, the boreholes were closed with a cement-bentonite mixture.

2.2. HYDRAULIC CONDUCTIVITY TESTING AND WATER LEVEL MEASUREMENTS

In-situ hydraulic conductivity tests (bail tests) were performed on eight of the shallow monitoring wells to determine representative hydraulic conductivities of the unconsolidated glacial sediments. The tests were performed by rapidly removing

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three to five gallons of water from the wells using a PVC bailer and measuring the rate of water level recovery with either a steel tape or an electric water-level indicator. The hydraulic conductivity of the sediments surrounding the screened portion of the well is a function of the rate of water level rise in the well and the well geometry. Values of hydraulic conductivity were calculated using the method of Hvorslev (1951) and a microcomputer for data handling. The data worksheets and a description of the test methods are included in Appendix B.

Depths to water were measured in all monitoring wells and three of the deep plant wells shortly after well completion, prior to performing the bail tests and prior to collection of water samples. Water levels were measured with either a steel tape or an electric water level indicator. The elevation of the measuring point (from which water levels are measured) for each well was surveyed to the nearest 0.01 foot (Table 2). All depth to water measurements and water-level elevations are listed in Table 3.

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2.3. WATER SAMPLING

Two sets of water samples were collected from the monitoring wells and the three deep plant wells for chemical analysis. A re-sampling of monitoring well GM-7D was also conducted. Monitoring Well GM-15, which was installed as part of the second phase of field activities, was sampled only once. In addition, water samples were collected from the on-site storm sewer, from the unnamed tributary to Delaware Creek, the plant municipal water supply and from standing water in an open excavation where an underground gasoline tank was removed. The storm sewer sample was collected using a bottom-filling teflon bailer. The unnamed tributary to Delaware Creek was sampled immediately upstream and downstream from the Plant storm sewer discharge pipe. Sampling logs, chain-of-custody forms and a description of sampling methods and quality control procedures are included in Appendix C.

The initial sampling of wells was conducted between March 28 and April 2, 1986. The parameters and chemical constituents analyzed are listed in Table 4. In addition to the priority pollutant chemicals and several indicator parameters, other non-priority pollutant constituents were selected for analysis because of their use on-site.

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The second set of ground water samples was collected between September 30 and October 4, 1986. Parameters analyzed during the second sampling are listed in Table 4. These parameters were chosen based on detection and quantification results from the first set of sample analyses. A sample of the on-site storm sewer water was collected on October 15, 1986. Resampling of the wells for base/neutral compounds was conducted between November 17 and November 20, 1986 by the analytical laboratory under G&M supervision because samples for analysis of the base/neutral extractable priority pollutants were not extracted within the proper holding time. Well GM-7D was resampled on February 10, 1987 and analyzed for base/neutral extractable organics only, because these parameters were not analyzed in the sample collected from GM-7D during the second round of sampling (October/November 1986). Monitoring Well GM-15, which was installed on February 12, 1987, was sampled on March 21, 1987.

In addition to sampling the monitoring wells and plant wells, samples were collected from the storm sewer, Delaware Creek (immediately upstream and downstream from the storm sewer outlet), and the plant municipal water supply. A sample of the NAPL occurring in well GM-12 was also collected for analysis. All analytical results are summarized in Tables 5 and 6 and laboratory reports of all analyses are included in Appendix E.

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2.4. OTHER INVESTIGATIONS

Additional field activities (conducted as part of the second phase of field investigations) consisted of an assessment of the sanitary sewer sump located immediately to the east of the smaller plasticizer tanks within the plasticizer tank farm, and an assessment of a sump located on the west side of the molding compound plant (Figure 2). The results of these assessments are presented in Sections 4.1.5 and 3.2.3.1, respectively.

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3.0 HYDROGEOLOGIC ASSESSMENT

This section presents the results of regional and site specific hydrogeologic investigations for the Plaskon site. In particular, regional and site specific geology, hydraulic parameters, ground-water flow directions and rates, and ground-water use are discussed.

3.1. REGIONAL HYDROGEOLOGY

The regional geology of the Toledo area is illustrated by the geologic cross-section in Figure 4 and the description of geologic units in Table 7. Generally, between 0 and 120 feet of unconsolidated glacial sediments overlie a thick sequence of dolomite and limestone bedrock.

The unconsolidated glacial sediments are primarily till, an unsorted and unstratified mixture of clay, silt, sand, and some pebbles and cobbles. Overlying the till in many areas is a thin veneer of lacustrine (lake-deposited) silt and clay. The glacial sediments generally are not used as a source of ground water

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because they will not readily yield economical quantities of water to wells. Some sandy and gravelly zones may occur in the till, but these generally are thin and do not provide adequate supplies of water. One exception is a sand and gravel deposit that fills a southwest-northeast trending bedrock valley located about one mile northwest of the Plaskon site (Figure 5). A 116-foot deep well (owned by the Toledo Cut Stone Company) located about 2 miles northwest of the Plaskon site is reported to yield 100 gallons per minute from this sand and gravel deposit (Hallfrisch, 1986).

The dolomite and limestone formations which underlie the site are part of the Silurian dolomite aquifer. The dolomite aquifer is the primary source of ground water in the area. Ground water in the dolomite aquifer moves through a complex network of interconnected fractures and crevices, some of which have been enlarged by dissolution of the carbonate rock. The thickness of the dolomite aquifer in the Toledo area ranges between 350 and 850 feet. The uppermost bedrock unit at the Plaskon site is the Greenfield Dolomite (Table 7).

The configuration of the regional water table in the Toledo area in 1970 is shown in Figure 6. Generally, the water table is within a few feet of the land surface. Horizontal gradients

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(slope of the water table) range from about 5 feet per mile (0.001 feet/foot) to about 10 feet per mile (0.002 feet/foot), except near the major streams where gradients are much steeper. The Plaskon site is situated on a ground-water high (divide) between Swan Creek to the northwest and Delaware Creek and the Maumee River to the southeast.

The potentiometric surface of the dolomite aquifer in 1970 is also shown in Figure 6. This surface depicts the level to which water will rise in a tightly cased well that penetrates and monitors the dolomite aquifer. Prior to ground-water development in the area, the potentiometric surface was at an elevation equal to or above the water table and flowing wells were common in the major river valleys (Kunkle, 1971). Ground water within the dolomite aquifer generally moved to the north and east and discharged into Lake Erie; however, flow also occurred toward the Maumee River, which also acts as a discharge boundary. Over-development of the dolomite aquifer has greatly reduced the hydraulic head in the aquifer, resulting in a decline of the potentiometric surface.

Since the 1960's pumpage from the aquifer has decreased and the potentiometric surface has recovered somewhat. This recovery is illustrated by the water-level hydrograph for the U.S. Geological

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Survey's monitoring well LU-1 (Figure 7), which is located at the Toledo State Hospital, about 4,000 feet northeast of the Plaskon site (Figure 1). The large water level declines shown on the hydrograph between 1948 and 1958 were caused by overdevelopment of the limestone aquifer. Since 1966, the water level has recovered about 35 feet. The U.S Geological Survey (USGS) is currently preparing a new potentiometric surface map of the dolomite aquifer (Personal Communication, Kevin Breen).

The declines in the potentiometric surface of the dolomite aquifer have resulted in large differences in the hydraulic head between the shallow ground-water system (glacial sediments) and the dolomite aquifer. This difference in hydraulic head, which is referred to as the vertical head loss through the glacial drift, is shown in Figure 8. Vertical gradients were greater than 0.5 feet/foot throughout much of the area and were 1.0 feet/foot in many places, including the area of the Plaskon site. The potentiometric surface has partly recovered since 1970, and is expected to continue to recover over the next 10 to 20 years. This will result in a decrease of the downward vertical gradients at the Plaskon site in the future.

As a result of the present vertical hydraulic gradients between unconsolidated sediments and the dolomite aquifer, ground water

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has the potential to move downward as well as laterally through the unconsolidated sediments. Figure 9 is a generalized geologic cross-section that extends from Swan Creek southeast across the Plaskon site to the Maumee River. The schematic cross section illustrates the general setting of the Plaskon site with respect to the local geology, water table, dolomite aquifer potentiometric surface, and surface water features.

3.2. SITE HYDROGEOLOGY

3.2.1. GEOLOGY

Geologic logs of all monitoring wells and well PW-2 are included in Appendix A. The site geology is illustrated by the geologic cross-section in Figure 10. Approximately 70 feet of unconsolidated glacial sediments overlie the dolomite bedrock at the site. Generally, between 2 and 10 feet of fill material, consisting of sand, silt, clay, and gravel, occurs at the surface. At some well locations, a sequence of sandy silt, silty sand or clayey silt occurs below the fill. These sediments, which are probably modified lacustrine and till deposits described by Kunkle (1971), generally extend to depths of between 10 and 15 feet. Glacial till occurs below the silt and extends

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to bedrock. The till is primarily clay, but includes some silt, sand, and gravel.

3.2.2. HYDRAULIC PARAMETERS

3.2.2.1. Glacial Sediments

Values of hydraulic conductivity determined from the bail tests performed on the shallow monitor wells at the Plaskon site and values reported in the literature for the glacial sediments in the Toledo area are summarized in Table 8. Hydraulic conductivities determined from in-situ bail tests are primarily representative of the horizontal hydraulic conductivity (hydraulic conductivity in the horizontal direction), which in fine-grained layered sediments may be one or more orders of magnitude greater than vertical hydraulic conductivities. Hydraulic conductivities determined from the bail tests range between 3.2×10^{-6} cm/sec (0.009 ft/day) and 6.9×10^{-5} cm/sec (0.2 ft/day) and have a geometric mean of 1.8×10^{-5} cm/sec (0.08 ft/day). These values are similar to values reported by Kunkle (1971) determined from laboratory tests and values reported by Starkey (1985) determined by both laboratory tests and in-situ bail tests.

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Kunkle reported an estimate for the average vertical hydraulic conductivity of the glacial sediments of 1.4×10^{-7} cm/sec (0.0004 ft/day) based on an area-wide recharge estimate and Starkey reported estimates of vertical hydraulic conductivity based on lab tests of 1.5×10^{-6} cm/sec (0.0043 ft/day) to 5.5×10^{-7} cm/sec (0.0016 ft/day). Starkey concluded that vertical hydraulic conductivities were about two orders of magnitude less than horizontal hydraulic conductivities and that below about 25 feet, hydraulic conductivities were more uniform and generally decreased to about 10^{-7} cm/sec.

3.2.2.2. Dolomite Aquifer

Estimates of the hydraulic conductivity of the dolomite aquifer were made based on an analysis of data from pumping tests that were conducted on the Plaskon plant wells by the U.S. Geological Survey in 1947. Values of transmissivity and storage coefficients determined from the tests are summarized in Table 9. Methods used to analyze the data are outlined in Appendix B.

The average transmissivity determined for the five plant wells using both drawdown and recovery data is 8,000 gpd/ft (gallons per day per foot). The calculated storage coefficients of $1.4 \times$

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10^{-4} to 3.1×10^{-5} are within the range expected for a leaky confined aquifer. A qualitative evaluation of the influence of flow from the glacial sediments to the dolomite aquifer during the pumping test indicated that leakage from the overlying glacial sediments was occurring.

Hydraulic conductivity is related to transmissivity by the equation:

$K = T/b$, where

K = hydraulic conductivity

T = transmissivity

b = saturated thickness of the aquifer

Based on an average saturated thickness of the dolomite aquifer of 450 feet, the average hydraulic conductivity is estimated to be 17.8 gpd/ft² or 8.4×10^{-4} cm/sec (2.4 ft/day). This value is in agreement with Kunkle (1971) who indicated that hydraulic conductivities of the dolomite aquifer are generally less than 2.4×10^{-3} cm/sec (6.7 ft/day) in the Toledo area.

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3.2.3. GROUND-WATER FLOW

3.2.3.1. Water Table

Configurations of the water-table at the Plaskon site for four dates - March 26, 1986; October 4, 1986; November 17, 1986; and February 10, 1987 are shown in Figures 11, 12 and 13 and 14. The map for October represents the period of highest measured water levels and the November map represents the period of lowest measured water levels. All water level measurements are listed in Table 3. Because the gravel pack in all the shallow monitoring wells extends to within 7 feet of the land surface, the measured water levels are representative of the water table surface.

The water-table configuration is similar for all four dates and generally agrees with the regional setting (being situated on a ground-water divide) discussed previously, except for an anomalous depression in the center of the site near well GM-5. There are numerous building sumps in the vicinity of GM-5, including a french drain system around the foundation of the molding compound plant, that are the apparent cause of this depression.

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The second phase of field activities included an investigation of the sump located on the east side of the molding compound plant. Site plans indicated that a 6-inch diameter perforated pipe, which is part of the french drain system identified above, was located around the entire perimeter of the building. The perforated pipe appeared to drain into the sump through an 8 to 10-inch diameter pipe. The water-level in the sump is maintained at approximately 4.4 feet below the basement floor. The elevation of the basement floor relative to mean sea level is 610.7 ft; the water level in the sump is therefore maintained at approximately 606.3 ft (MSL), which is 13-17 feet lower than natural ground-water elevations at the site.

At the northwest and southeast borders of the site the water table gradient is about 1 foot/150 feet (0.007) and at the center of the site, within the depression, the gradient is about 1 foot/40 feet (0.025).

3.2.3.2. Potentiometric Surface of Dolomite Aquifer

Water levels measured for four dates in the three deep plant wells (PW-1, PW-3, and PW-5) and the two monitoring wells that penetrate the top of the dolomite aquifer (GM-7D and GM-11D) are

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shown on Figure 15. Because the plant wells are completed at different depths than the monitor wells and because of the limited number of deep wells, the data do not provide a precise direction of ground-water flow in the dolomite aquifer beneath the plant site. In the three plant wells, water levels for all four dates are highest in PW-1 and lowest in PW-5. This suggests that the direction of flow is from the north to the south or southeast. Based on measurements in wells GM-7D and GM-11D, however, movement may be to the north. Continued measurement of the site wells and evaluation of the new potentiometric surface map being prepared by the U.S. Geological Survey (when available) is necessary to better determine the direction of flow within the dolomite aquifer below the Plaskon site.

3.2.3.3. Ground-Water Flow Gradients and Velocity Calculations

The average linear velocity of ground-water movement can be estimated by rearranging Darcy's Law, $Q = KIA$ to:

$$V = \frac{KI}{n}$$

where,

V = velocity, feet/day

K = hydraulic conductivity, feet/day

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I = hydraulic gradient, feet/foot

n = effective porosity (dimensionless, varies from .20 for the glacial materials to .10 for the dolomite).

There are both horizontal and vertical components of flow present at the Plaskon Site. The actual direction of flow is, at any one point, the vector sum of the various horizontal and vertical flow components. In general, the near surface flow directions will be dominated by surface streams or structures such as the french drains or building sumps. Deeper within the glacial sediments, flow toward the dolomite aquifer will dominate.

Horizontal gradients and permeabilities for the glacial sediments yield an estimated horizontal ground-water flow velocity of .2 to 2 feet/yr.

Based on the difference in water levels in wells GM-7S and GM-7D (Table 3), the vertical hydraulic gradient between the glacial sediments and the dolomite aquifer at the Plaskon site is between 0.95 feet/foot and 1.0 feet/foot. Based on the water level record for the U.S. Geological Survey monitoring well LU-1, it appears that the vertical gradient has been approximately 1.0 feet/foot since manufacturing activities began at the Plaskon site. As the potentiometric surface of the dolomite aquifer continues to recover, the vertical gradient will decrease.

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Assuming that the average vertical hydraulic conductivity is between 1×10^{-7} cm/sec (0.0003 ft/day) and 1×10^{-6} cm/sec (0.003 ft/day) and the vertical gradient is 1.0 feet/foot, the calculated average linear velocity is between 0.002 ft/day and 0.02 ft/day, or about .7 feet/year to 7 ft/year. Within the level of accuracy for these measurements, the horizontal and vertical rate of movement of ground water within the glacial sediments is approximately equal.

Based on an average horizontal hydraulic conductivity for the dolomite aquifer of 2.4 ft/day, a hydraulic gradient of 0.004 feet/foot (20 feet/mile - based on regional potentiometric surface map in Figure 6) and an effective porosity of 0.10, the average linear velocity of ground-water in the dolomite is estimated to be 0.1 ft/day or about 35 feet/year.

3.2.4. GROUND-WATER USE

Potential ground-water users within 1 mile of the Plaskon site were identified using information from the Ohio Department of Natural Resources (ODNR) and the U.S. Geological Survey (USGS). Only three wells were identified within 1 mile of the plant; Well LU-1, Well 193, Well 218 (Figure 1). Well LU-1, at the Toledo

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State Hospital, is currently used as a water-level observation well by the U.S. Geological Survey and is not used for water supply. Well 218, which was drilled in 1953 at 2315 Byrne Rd., was field checked by the U.S. Geological Survey and found to no longer exist. Well 193, which was drilled in 1954 about 500 feet south of Swan Creek on the east side of Byrne Road also could not be located by the USGS. The area is currently occupied by a church and apartment buildings. Well log information from the ODNR is available for other wells between 1 and 2 miles from the site. However, the closest well currently in use which could be documented by the U.S. Geological Survey is approximately 1.9 miles from the Plaskon site. Many of the wells on file with the ODNR were drilled in the 1950's and 1960's and are believed by the DNR to no longer be in use because the Toledo municipal water supply system now supplies the entire area. Discussions with the Department of Health also indicated no active (or inactive) nearby wells.

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4.0 SOIL AND WATER QUALITY ASSESSMENT

This section is organized into two primary subsections. The first subsection presents results of the field investigations concerning the nature and extent of soil and ground water contamination. The last subsection discusses potential impacts associated with contamination observed at the site. These discussions include comparisons of contaminant concentrations with available water quality criteria, transport and fate characteristics, identification of potential migration pathways and receptors, and a qualitative assessment of potential risks.

4.1. RESULTS OF CHEMICAL ANALYSES

Results of chemical analyses of water samples collected from the Plaskon site during both Spring 1986 and Fall 1986 are included in Tables 5 and 6. Results of chemical analyses of soil samples collected from the Plaskon site during Spring 1987 are included in Tables 13 and 14. Copies of all laboratory reports are included in Appendix E. Analytical results for inorganic chemicals in water are reported in milligrams per liter (mg/l), which generally is equivalent to parts per million; whereas,

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results for most organic chemicals are reported in micrograms per liter (ug/l) for water samples and milligrams per kilogram (mg/kg) for soil samples, which generally are equivalent to parts per billion and parts per million, respectively. To maintain consistency with the reported results and the text, mg/l, ug/l, and mg/kg are used in the following discussion.

All analytical results are subject to some uncertainty because of bias introduced during sampling and in the laboratory. Such biases are especially significant for organic chemicals which commonly have detection limits in the low ug/l range. Three primary sources of bias in ground-water monitoring are: monitoring system (well) installation, sampling and sample handling, and laboratory analyses. Quality control procedures undertaken during this study to reduce the possibility of biases introduced by these three sources are discussed in Section 2.1 (well construction) and Appendix C (sampling and laboratory procedures).

The field and laboratory quality assurance/quality control (QA/QC) program for ground-water sampling included collection of field and trip blank samples. A field blank is a distilled water sample that is transferred directly into the sample bottle and transported to the site to determine if contaminants had entered

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the sample container from other sources. A trip blank is a distilled water sample that has been exposed to sampling processes (i.e. bailer, filter system).

Table 10 is a summary of organic compounds detected in the trip and field blanks and the plant municipal water supply during both rounds of water sampling. A discussion of sampling quality control procedures is provided in Appendix C. Of those compounds detected in blank samples, chloroform, methylene chloride, toluene, and bis (2-ethylhexyl) phthalate also were detected in wells at the Plaskon site. Methylene chloride and phthalates commonly occur in laboratory environments and often are detected at relatively low ug/l concentrations in water samples. Consequently, detection of these two compounds at low ug/l concentrations in water samples cannot be considered a definite indication of the presence of these chemicals in the environment (Saar and Spriezer, 1985). In addition, if an organic compound detected in trip blanks is also detected in any ground-water sample at or below the concentrations reported for the trip blanks, then the presence of that compound in the ground-water sample may be the result of contamination introduced during sample collection. Similarly, if an organic compound detected in field blanks is also detected in any ground-water samples at or below the concentrations reported for the field blanks, then the

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presence of that compound may be the result of laboratory contamination.

As part of the sampling and laboratory quality control program, duplicate ground-water samples were obtained from Well GM-6 and GM-11 during the first round of sampling, and from GM-4 and GM-11D during the second round of sampling. In general, the results indicate that the sample concentrations are consistent and compare favorably. The inconsistency in total suspended solids concentrations between the sample from GM-6 and the respective duplicate sample (obtained during the first round of sampling) may be a result of the disturbance incurred on particulate solids that may have previously settled at the bottom of the well, which caused the solids to become suspended within the water column. The turbidity of the second (duplicate) sample would thus be increased, as evidenced by the results shown in Table 5. Another inconsistency in measured constituent concentrations for duplicate water samples is evidenced by the chloride values for well GM-6 (280 and 1680 mg/l) obtained during the March/April 1986 sampling round. This discrepancy is likely attributed to laboratory error. Other than this anomalous measurement, inorganic and organic laboratory data for duplicate samples obtained from wells GM-4, GM-6, and GM-11D compare very well, which assures reproducibility of results.

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4.1.1. WELLS

To determine if ground-water quality at the Plaskon site has been changed by release of chemicals resulting from site activities, an estimate of background concentrations for the various parameters and constituents is necessary. Because of the water-table configuration and ground-water flow directions at the site (Figures 12, 13, 14 and 15), none of the shallow monitor wells can be unequivocally considered to be upgradient from possible sources of contamination. However, well GM-1, which is located in the northwest corner of the site and furthest from site activities, most likely represents background conditions not affected by site activities. Ground water sampled from wells GM-2, GM-8, GM-9 and GM-10, which are located along the northern and eastern property boundaries of the site, has been found to contain concentrations for most parameters and chemical constituents that are similar to those detected in well GM-1. The concentrations detected in these wells are within typical ranges expected for natural ground waters in urban environments. Concentrations of dissolved solids for these wells range between about 410 mg/l and 530 mg/l. Concentrations of chloride and sulfate generally are less than about 15 mg/l and 70 mg/l, respectively. Except for low concentrations of phthalates detected during the first round of sampling and a low

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concentration of methylene chloride detected in the sample from GM-2 during the second round, no priority pollutant organics were detected in any of these wells. Therefore, these wells appear to yield ground-water samples representative of background conditions and unaffected by site activities. In the following discussions, these wells will be considered as background wells for water quality comparisons.

Table 11 is a summary of all organic compounds detected in water samples from wells and inorganic constituents that occurred at concentrations higher than concentrations in background wells. The most significant occurrences were found in the following monitor wells:

GM-12 - A non-aqueous phase liquid (NAPL) layer composed primarily of bis (2-ethylhexyl) phthalate, with smaller amounts of polynuclear aromatic hydrocarbons and volatile organic compounds occurs in well GM-12. An analysis of the NAPL is included in Table 6. This well is located at the site where a spill of phthalate plasticizer was reported. The first water sample from this well contained 3700 ug/l of bis (2-ethylhexyl) phthalate, but did not contain detectable levels

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of polynuclear aromatic or volatile organic compounds. The second water sample contained an increased concentration of bis (2-ethylhexyl) phthalate and also contained anthracene, naphthalene, and fluoranthene. However, the laboratory reported that this sample contained globules of the NAPL, which were included in the analysis. Therefore, the second analysis is not considered representative of ground water occurring beneath the NAPL layer at this site.

GM-6 - This well is located near the reported methylene chloride release in Area 3 and contained methylene chloride concentrations of 3200 ug/l and 9600 ug/l, respectively, for the two sampling dates. Concentrations of vinyl chloride, chloroform, 1,1-dichloroethylene and 1,2-trans-dichloroethylene, all less than 10 ug/l, also were detected. The detection of vinyl chloride in these samples may be a consequence of the polyvinyl chloride (PVC) well construction material interacting with the methylene chloride. However, vinyl chloride is also a reported degradation product of 1,2-trans-dichloroethylene.

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GM-4 - This well is located at the former site of the wet-dust settling pond. Ground-water samples from this well contained 996 mg/l and 1130 mg/l of ammonia-nitrogen and 26.3 mg/l and 40.8 mg/l of formaldehyde.

Other organic constituents detected in wells include:

Phthalates - Low (less than 73 ug/l) concentrations of phthalates, primarily bis (2-ethylhexyl) phthalate, were detected in 16 of the 18 wells monitored during the first round of sampling. Low concentrations (less than 7 ug/l) of bis (2-ethylhexyl) phthalate and di-n-octyl phthalate were also detected in new monitor well GM-15 (sampled March 21, 1987). During the second round of sampling (including the resampling of well GM-7D), phthalates were detected only in well GM-12. The presence of phthalates in ground water from well GM-12 is not unexpected, since a NAPL layer containing percent concentrations of phthalates was observed on the water table during installation of the well and subsequent sampling events. For many wells, however, detection limits for the second set of analyses were higher than concentrations detected during the first sampling. The first set of samples were analyzed for all base-neutral

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extractable priority pollutant compounds (which includes phthalates) using EPA Method 624, which utilizes a gas chromatograph/mass spectrometer, and the second set of samples were analyzed for only phthalates using EPA Method 606, which utilizes a gas chromatograph. The analytical laboratory indicated that compounds other than phthalates eluting from the sample during the analyses resulted in the higher detection limits for the second set of analyses. As discussed previously, the trip blank from the first sampling round contained 29 ug/l of bis (2-ethylhexyl) phthalate, a concentration greater than was detected in all but three of the 16 wells in which it was detected. This suggests that the first set of analyses were biased either by sampling techniques or by the laboratory environment. Because phthalates are ubiquitous in the environment, low levels of detection in otherwise uncontaminated samples are not uncommon.

Phenol and anthracene - Low concentrations of phenol (maximum of 35 ug/l) were detected in wells GM-7D, GM-11D, and PW-5 and 2.5 ug/l of anthracene was detected in well GM-7D during the first round of sampling. During the second round of sampling, low concentrations of total phenols (maximum of 14 ug/l) were detected in Wells GM-11D and PW-1.

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Anthracene was analyzed for in samples collected from wells GM-7D and GM-12 only and the storm sewer sample during the second round of sampling. The concentration of anthracene in well GM-12 changed from less than 1 ug/l to 530 ug/l between sampling rounds, most likely because of the presence of globules of NAPL in the second round sample. The low concentrations of phenol and anthracene encountered during the initial sampling round in GM-7D were not detected during subsequent sampling. Neither anthracene nor phenol were detected in the storm sewer water sample.

The following wells contained concentrations of inorganic constituents greater than the concentrations found in background wells:

GM-3 - high dissolved solids and sulfate

GM-5 - high dissolved solids and chloride

Concentrations of dissolved solids were 40-130 mg/l higher in wells GM-7S, GM-13 and GM-14 than observed in samples from the background wells. Elevated concentrations of dissolved solids, chloride, and sulfate in ground water are not uncommon in urbanized areas due to routine activities such as application of deicing salts and runoff from building roofs and parking lots.

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With the exception of wells GM-4 and GM-6, concentrations of most metals did not exceed background concentrations, which generally were either below or only slightly above detection limits. None of the metals for which Maximum Contaminant Levels (MCLs) have been established (under the Safe Drinking Water Act) were present at concentrations exceeding the MCLs.

Shallow on-site wells having concentrations of some of the indicator parameters above concentrations found in well GM-1 and other comparison background wells include:

| | |
|-------|--|
| GM-2 | Chemical Oxygen Demand - 230 mg/l |
| GM-14 | Chemical Oxygen Demand - 165 mg/l, Total Organic Halogens - 0.76 mg/l |
| PW-3 | Total Organic Halogens - 0.56 mg/l |

These constituent concentrations in themselves do not indicate risks to potential off-site ground-water receptors.

With respect to ground-water quality within the dolomite aquifer at the Plaskon Electronic Materials Site, the following organic compounds were detected at concentrations of 4.9 to 120 ug/l in monitoring well GM-7D during the initial round of sampling: di-

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n-butyl phthalate, bis (2-ethylhexyl) phthalate, phenol, anthracene and formaldehyde. Further ground-water sampling of GM-7D should be conducted to determine if the initial detection of these compounds was the result of laboratory or sampling error.

A similar situation with respect to water quality fluctuations is observed at GM-11D. During the first round of ground-water sampling, the following organic compounds were detected at concentrations ranging from 1.4 to 8.5 ug/l: di-n-butyl phthalate, bis (2-ethylhexyl) phthalate and phenol. During the second round sampling of GM-11D, the aforementioned constituents were not detected; however, benzene, methylene chloride, and toluene were detected at concentrations of 1.2 to 19 ug/l. Given the limited water quality data base and the uncertain ground-water flow system within the dolomite aquifer, a confident interpretation of the available data is not possible. The detected methylene chloride at GM-11D during the second round of sampling may represent laboratory related contamination (methylene chloride was detected at 24 ug/l in the trip blank for this round of sampling and analysis).

Bis (2-ethylhexyl) phthalate was detected at concentrations ranging from 7.2 to 27 ug/l in Plant wells PW-1, PW-3 and PW-5

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during the first round of sampling. However, bis (2-ethylhexyl) phthalate was detected at 29 ug/l in the trip blank for this round of sampling and analysis and indicates the potential for laboratory induced contamination by this compound. Bis (2-ethylhexyl) phthalate was not detected in any of these wells during the second round of sampling. The concentration of bis (2-ethylhexyl) phthalate (3.9 ug/l) at PW-5 during the initial round of sampling is less than the detection limit for this constituent during the second round of sampling; the presence of this constituent at the aforementioned concentration is therefore uncertain. For the reasons identified above, an interpretation of the water quality fluctuations at the plant wells is not made at the present time; further sampling and analyses is needed for reliable conclusions to be made. The tentative interpretation given the available data set is that laboratory and sampling bias are the source of the water quality changes in these wells, but for the risk assessment analysis the highest concentrations found were used.

4.1.2. GASOLINE TANK EXCAVATIONS

Three water samples were collected from standing water in an open excavation during removal of an underground gasoline tank about

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100 feet east of well GM-4 in April, 1986. These samples contained concentrations of benzene and toluene and lower concentrations of 1,2 -dichloroethane and ethylbenzene. Plant personnel state that the tanks showed no signs of leaks when inspected after removal and that there was no apparent contamination of adjacent soils. They believe that a small amount of gasoline may have leaked into the pit when piping was disconnected. As a result of the reported leaks, the collected samples are not considered indicative of ambient ground-water quality at that location.

4.1.3. STORM SEWER

The water sample from the storm sewer, which was collected by the automatic portable sampler in the storm water shed during the second round of field activities, contained detectable concentrations of eight polynuclear aromatic (PNA) compounds and two phthalate compounds. The eight PNA compounds detected were benzo (a) anthracene, benzo (a) pyrene, 3,4-benzofluoranthene, benzo (k) fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene. Concentrations of these PNA compounds ranged from 3.9 to 16 ug/l.

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Of these PNA compounds detected in the storm sewer sample, only benzo (a) pyrene and fluoranthene were also detected in the NAPL sampled. However, the detection limits for the PNA analysis of the NAPL samples were greater than the reported levels in the storm sewer. Therefore, all PNA compounds detected in the storm sewer may have been present in the NAPL sampled.

The two phthalate compounds detected in the storm sewer sample were bis (2-ethylhexyl) phthalate and di-n-octyl phthalate with reported concentrations of 1400 ug/l and 380 ug/l, respectively. No volatile organic compounds were detected.

4.1.4. UNNAMED TRIBUTARY TO DELAWARE CREEK

Analyses for the five priority pollutant phthalate esters were conducted on two water samples collected from the unnamed tributary to Delaware Creek during the second round of sampling. Bis (2-ethylhexyl) phthalate and di-n-butyl phthalate were detected in the sample from upstream of the storm sewer discharge point at concentrations of 9 ug/l and 19 ug/l, respectively. In the sample from downstream of the storm sewer discharge, only bis (2-ethylhexyl) phthalate at a concentration of 597 ug/l was detected; as indicated above, bis (2-ethylhexyl) phthalate was

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one of two phthalate compounds detected in the storm sewer water sample. Water samples from the tributary were not analyzed for volatile organics or PNA compounds, because volatile organics were not detected in the storm sewer sample, and the highest detected concentration of a PNA compound was 16 ug/l (fluoranthene). Given these storm sewer sample concentrations and the expected dilution within the tributary, detectable concentrations of these compounds resulting from the storm sewer discharge are not expected to be found in the surface water of the tributary .

4.1.5. PLASTICIZER TANK FARM AREA

To delineate the areal extent of NAPL in the vicinity of the plasticizer tank farm, fourteen soil borings (TB12A-TB12N) ranging in depth from 10 to 18 feet were performed in the vicinity of the tank farm (Figure 16). The subsoils encountered generally consisted of green-gray to brown-gray sandy to clayey silt. A summary of soil boring information obtained during the investigation of the tank farm area is presented in Table 12 and Appendix A.

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Liquid samples obtained from the boreholes were visually monitored for the presence of NAPL using a clear bailer. The NAPL occurred as a clear to light brown oily liquid that contained small dark-brown globules. The liquid and globules were generally present as a floating layer on top of the water.

The areal extent of observed NAPL, shown in Figure 17, is estimated to be 28,000 square feet (0.64 acre). Within this area, the following thicknesses of NAPL were observed (using the clear bailer):

- o Less than 0.01 feet at TB-12B, TB-12D, TB-12E, TB-12G, TB-12I and TB-12M.
- o 0.01 to 0.02 feet at TB-12A, TB-12F and TB-12N.
- o 0.07 feet at TB-12H.

The thickness of the NAPL was also monitored in split-spoon soil samples obtained during drilling. Intervals of NAPL ranged from 0 to 7.5 feet, and visual estimates of NAPL concentration in the soil samples ranged from 0 to 20 percent.

Based on the areal distribution of NAPL observed in the soil borings, the NAPL has migrated approximately 150 feet to the southeast (downgradient) of the plasticizer tank farm. The

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direction of migration is away from the french drain system that collects ground water around the molding compound plant, but is toward the unnamed tributary to Delaware Creek. Assuming that a release of free product occurred in the early 1950's, (a release of phthalate plasticizers is believed to have occurred at that time), the rate of NAPL movement has averaged 4 feet per year.

To evaluate the vertical extent of chemical migration in the vicinity of the plasticizer tank farm, selected soil-boring samples were analyzed for base/neutral extractable organics and volatile organic compounds (VOCs). The results of these analyses are presented in Table 13 and Appendix E.

Bis (2-ethylhexyl) phthalate concentrations ranged from 53 to 450 mg/kg in soil samples obtained from depths of 5 to 7 ft. Bis (2-ethylhexyl) phthalate concentrations decreased with depth, with 3.3 mg/kg detected in the sample collected from 8 to 10 ft and 0.73 mg/kg detected in the sample collected from 10 to 12 ft. A similar decreasing trend with depth was observed for di-n-octyl phthalate; however, concentrations of di-n-butyl phthalate ranged from 2.5 mg/kg (sample collected at a depth of 5 to 7 ft) to not detected (sample collected at a depth of 10 to 12 ft).

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Polynuclear aromatic (PNA) compounds were detected in two of the five soil samples analyzed, TB-12H AND TB-12M. However, only the sample from soil boring TB-12H contained PNA compounds at quantifiable levels. The PNA compounds detected in soil boring sample TB-12H were benzo (a) anthracene, benzo (a) pyrene, benzo (k) fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. Concentrations for each of the compounds ranged from 0.041 mg/kg to 0.1 mg/kg. All of these PNA compounds were also detected in either the NAPL sample or the storm sewer sample. Possible sources of the PNA compounds are discussed in Section 4.2.2

VOC's were detected in only one of the two soil boring samples analyzed, TB-12M. Benzene, chloroform, 1,2 dichloropropane, methylene chloride, 1,1,1, trichloroethane, and trichloroethylene were detected in this soil sample, with concentrations for each ranging from less than 0.0004 mg/kg to 0.1 mg/kg. Benzene and methylene chloride were also detected in the NAPL sample analyzed for VOC's.

The plasticizer tank farm area assessment included a field investigation of the out of service sanitary sewer sump located immediately to the east of the smaller plasticizer tanks and within the areal extent of NAPL shown on Figure 17. A liquid

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sample collected from the sump contained NAPL, similar in appearance to the NAPL encountered in Monitoring Well GM-12 and the adjacent boreholes identified above.

4.1.6. METHYLENE CHLORIDE TANK AREA

As shown in Figure 18, five soil borings were drilled in the vicinity of the methylene chloride tank. The purpose of the soil borings was to determine the horizontal and vertical extent of soil quality changes resulting from previous releases of methylene chloride. A summary of analytical results from these soil borings is presented in Table 14 and Appendix E. With analytical detection limits of 0.13 to 0.25 mg/kg, only one of eight soil samples analyzed contained detectable levels of methylene chloride. Methylene chloride was detected at a concentration of 0.15 mg/kg in sample TB-6D (7 to 9 ft).

Visual observations were conducted on liquid samples obtained from the soil borings as well as from existing monitoring well GM-6. Slight odors were noted from liquid samples obtained from soil boring TB-6D and Well GM-6. In addition, a slight oily sheen was observed on the liquid sample from TB-6A. However, the HNu organic vapor analyzer used to field screen soil-boring

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samples did not detect VOC concentrations in excess of background levels (generally considered to be between 5-10 ppm). No physical evidence of volatile chemical presence was observed in liquid samples obtained from the other boreholes.

4.2. SITE ASSESSMENT

In order to assess the results of the environmental sampling conducted at the Plaskon site the following subsections will: 1) identify those constituents that have been detected at concentrations approaching or exceeding existing water quality criteria, standards or advisories; 2) describe the transport and environmental fate of the various constituents within the ground-water system; 3) estimate at what time and concentrations various constituents may reach a down gradient receptor or discharge point; and 4) qualitatively discuss potential exposure routes, public health and environmental risks.

4.2.1. DETECTED CONSTITUENTS

To evaluate the significance of the constituents found in the ground water beneath the site, drinking water standards,

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advisories and criteria were used although this water is not a drinking water source. The risk assessment will address the off-site significance of any constituents found.

The primary chemical constituents detected in ground water samples at the Plaskon site include formaldehyde and ammonia-nitrogen in well GM-4 and priority pollutant organic compounds in wells GM-6 and GM-12. Maximum concentrations and existing water quality criteria for the priority pollutant organic constituents detected in water samples from wells are listed in Table 11.

Vinyl chloride in well GM-6 is the only constituent detected at a concentration exceeding a currently existing proposed Maximum Contaminant Level (MCL). The presence of this compound may be the result of 1,2-trans-dichloroethylene degradation (also detected in ground water from Well GM-6) or contaminated ground water interaction with the PVC well construction material. The concentrations of methylene chloride detected in Well GM-6 exceed lifetime health advisories. These advisories are non-mandatory guidelines established by the U.S. EPA for drinking water suppliers. Additional regulatory criteria (MCL and MCLG) for methylene chloride in drinking water are scheduled to be established by the USEPA in the near future. Additionally, the NAPL sampled from Well GM-12 was found to contain bis (2-

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ethylhexyl) phthalate, several polynuclear aromatic compounds, and volatile organic compounds.

Although no criteria exist for formaldehyde and ammonia-nitrogen, the USEPA has suggested an ambient goal of 41.4 ug/l (0.041 mg/l) for formaldehyde and the World Health Organization has established a recommended drinking water standard of 0.5 mg/l for un-ionized ammonia.

The primary organic compounds detected in soil samples collected from the site were methylene chloride, bis (2-ethylhexyl) phthalate, di-n-butyl phthalate, and nine polynuclear aromatic compounds. There are no regulatory criteria available for acceptable levels of these compounds in soil.

4.2.2. TRANSPORT AND ENVIRONMENTAL FATE OF DETECTED CONSTITUENTS

Transport of organic compounds in ground water can occur in several phases, including non-aqueous phase liquid (NAPL), dissolved and vapor phases. Variables affecting transport include the physical and chemical properties of the organic compound and the aquifer materials and various physical,

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chemical, and biological processes occurring within the ground-water flow system.

Physical and chemical properties of the organic compounds detected in water samples (and the NAPL sample) from the Plaskon site are listed in Table 15; these include density, aqueous solubility, log octanol/water partitioning coefficient, and log Henry's Law constant.

Some organic compounds evaporate readily when released to the environment. These compounds are said to be volatile and are identified in Table 15 as those which have values of log Henry's Constant less negative than -3 (i.e. methylene chloride and benzene). These compounds may volatilize either from the liquid state as they move downward through the unsaturated zone to the ground water or may volatilize from the dissolved state within the ground water.

Organic compounds with high solubilities will dissolve readily in ground water and will move through the subsurface along the direction of ground-water flow. Liquid organic compounds that have low solubilities (relatively immiscible in water) may migrate within the ground water as a discrete non-aqueous phase. The migration of such a liquid is governed primarily by its

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density and viscosity. Low-density liquids will float on the water table and spread out in a down-gradient direction, whereas high-density liquids will sink through the saturated zone, displacing ground water as it moves vertically downward. If the organic liquid contains compounds slightly soluble in water, a plume of the dissolved compound will develop and move along the direction of ground-water flow. If the organic liquid contains more than one component, the components may dissolve in the ground water at different rates.

Once an organic compound is dissolved in the ground water it will be transported by the bulk motion of the flowing ground water by the process of advection. Many compounds, especially those with high solubilities, are quite mobile in ground water and will migrate at rates similar to that of the ground water. Other compounds, however, interact with the aquifer matrix and their movement is retarded with respect to that of the ground water. This interaction is affected primarily by the compounds' physical characteristics and the presence of organic matter in the aquifer. The octanol/water partition coefficient (Table 15) is a measure of the affinity of a chemical for the solid organic matter versus its affinity for water. Because of its large range in values the logarithm of the octanol/water partition coefficient is often reported; higher values indicate lower

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mobility (higher retardation) in the ground-water system and lower values indicate higher mobility (lower retardation).

The amount of retardation of a particular chemical can be expressed by a single constant referred to as the retardation coefficient. The retardation coefficient is as follows (Freeze and Cherry, 1979, p. 404):

$$R = 1 + (p/n)K_d$$

where p = bulk density of soil,
 n = effective porosity of soil,
 K_d = distribution coefficient, and
 R = retardation coefficient

The distribution coefficient (K_d) can be estimated from the octanol/water partition coefficient and the percent organic matter content of the soil. Values of K_d for organic compounds detected at the Plaskon site are listed in Table 16. An organic matter content of 1 percent (0.01), typical for a surface soil horizon, was used for the calculation.

In addition to the processes discussed above, transport of organic compounds in ground water is influenced by dispersion and

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degradation, both chemical and biological. Dispersion is the spreading of the compound along the flow path due to mechanical mixing and diffusion and results in a decrease in the maximum concentration of a chemical with increasing distance from the source. Chemical and biological degradation are complex processes that are not easily quantified and are not discussed in detail in this report.

The general mobility and fate of the constituents of interest at the Plaskon site are outlined below:

- o Bis (2-ethylhexyl) Phthalate - Bis (2-ethylhexyl) Phthalate has a low solubility (0.4 mg/l) and high K_d value (3,311,000) and thus is relatively immobile in ground water. Because of its low solubility and low density relative to water, it may occur as a non-aqueous phase liquid that will float on the water table. A floating NAPL layer, with bis (2-ethylhexyl) phthalate as a major component, has been observed downgradient of the plasticizer tank farm area.
- o Polynuclear Aromatic Hydrocarbons (PNAs) - The PNAs detected at the site have very low solubilities (generally less than 1 mg/l) and high values of K_d

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(generally greater than 100) and are therefore considered relatively immobile in ground water. The majority of these compounds will move at rates three or more orders of magnitude less than that of ground water. They tend to be strongly sorbed to soil particles in the unsaturated zone or sediments in streams. The occurrence of PNA's in the NAPL sample from GM-12 may result from dissolution by the phthalate liquid of PNAs on particulates in soils on the property. PNA compound laden particulates may be from atmospheric deposition of combustion products from the coal-fired power plant at the site. The presence of PNA's in the storm sewer sample may result from runoff and erosion of any PNA containing surficial soils during rainfall events.

- o Methylene chloride, vinyl chloride, and 1,2-trans dichloroethylene - All have low values of K_d (0.03 to 0.19) and relatively high solubilities (1 to 16,700 mg/l) and will move readily with ground water. They also are volatile.
- o Formaldehyde - Formaldehyde is considered mobile in ground water and biodegrades relatively rapidly.

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- o Phenol - Phenol has a low value of K_d (0.18) and high solubility (67,000 mg/l) and is considered mobile in ground water.

- o Ammonia-Nitrogen - The reported concentration of ammonia-nitrogen includes nitrogen as both the ammonium ion, NH_4^+ , and as un-ionized ammonia, NH_3 . At the pH and temperature of ground water collected from well GM-4, almost 99 percent is expected to be in the ammonium form (Thurston and others, 1974). The ammonium ion tends to sorb to soils and is transported relatively slowly in ground water. In strongly oxidizing conditions, NH_4^+ may convert to nitrate (NO_3) as part of a biochemical process mediated by a group of chemolithotrophic bacteria referred to as the nitrifiers; NO_3 is quite mobile in ground water.

4.2.3. TRANSPORT PATHWAYS AND ESTIMATES OF CONCENTRATIONS AT RECEPTORS

The organic compounds identified in shallow ground water and soil at several locations on the plant site do not appear to have moved vertically downward to the dolomite aquifer or laterally to

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the wells nearest the site boundaries. Transport of contaminants through volatilization from subsurface soil or wind and water erosion of subsurface soils are not considered significant migration pathways considering the topography and current development of the site. Therefore, this section addresses the possible pathways whereby contaminants in ground water may move off-site, estimates rates of movement, and identifies potential receptors. It must be emphasized that no off-site ground water transport of contaminants has been found to be occurring. However, contaminants detected in ground water at the site have been detected in a water sample from the storm sewer that discharges to the unnamed tributary of Delaware Creek.

The most likely pathways for movement of chemical constituents released to the ground water at the Plaskon site are 1) downward flow through the glacial sediments to the dolomite aquifer, then horizontal flow within the dolomite, or 2) interception of shallow ground water by french drains, the drainage pipe around the Molding Compound Plant, and possibly leaky sewers and subsequent discharges to surface water. Given that a ground-water ridge is present between the plasticizer tank farm area and the molding compound plant (Figures 11-14), the area of ground-water impact emanating from the plasticizer tank farm is not likely to migrate to the sump at the molding compound plant.

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However, the NAPL and affected ground water associated with the plasticizer tank farm may be intercepted by a building sump located inside of the Amino Molding Compound Plant. The configuration of the sewer system in the vicinity of the NAPL is shown in Figure 19. Also because Area 3 (methylene chloride storage) is potentially upgradient of the molding compound plant, the possibility exists for methylene chloride in ground water emanating from this area to migrate toward (and eventually be intercepted by) french drains which encircle the molding compound plant, and ultimately be discharged off-site (to Delaware Creek through the storm sewer) via the sump at the molding compound plant.

In addition to pathways for the movement of dissolved contaminants, the NAPL that occurs downgradient of the plasticizer tank farm area appears to be floating on the water table. The area of NAPL is estimated to be migrating to the southeast toward the unnamed tributary of Delaware Creek at approximately 4 feet per year as described in Section 4.1.5.

An estimate of the relative concentration and travel time for a chemical constituent in solution moving from the water table downward through the glacial till to the dolomite aquifer and laterally to a (theoretical) well 800 feet away at the site boundary was made. A similar estimate for the other likely

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pathway for off-site constituent migration identified above (leaky sewers) was not made, because Plaskon is currently conducting sewer inventory and repair as necessary, in order to ensure that the sewers are not pathways of release. A distance of 800 feet was selected because it represents the minimum distance between monitor well GM-4 (which appears to be affected by site activities) and the nearest downgradient location along Glendale Avenue. The estimate was made for a contaminant with a low K_d that moves at approximately the same rate as ground water (no retardation). Further, the effects of biodegradation are not taken into consideration; this represents an additional conservative assumption. The calculations therefore represent worst case conditions and are described as follows:

1) Travel Time

The vertical ground-water velocity through the glacial till was estimated to be between 0.7 and 7 feet per year. Thus travel time through the till would be between 9 and 90 years. Ground-water velocity through the dolomite was estimated to be about 35 feet per year, therefore, it would take about 23 years (after release from the glacial till to the dolomite) to travel 800 feet. For constituents with a retardation

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factor greater than one, the travel time may be one or more orders of magnitude greater, although most of the retardation would occur in the glacial sediments where the total organic carbon content is most likely greater.

2) Relative concentration

To determine the concentration of a chemical constituent at a receptor 800 feet away two factors were considered: 1) dilution of the plume upon entering the dolomite because of the difference in flow rates between water in the glacial sediments and water in the dolomite, and 2) dilution within the dolomite due to dispersion. All calculations for determining the two dilution factors are included in Appendix D. Combination of the two dilution factors results in a total estimated dilution by a factor of 160 to 5,000; the resulting predicted constituent concentrations are shown below:

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| <u>Constituent</u> | <u>Highest Detected Concentration</u> | <u>Estimated Range In Future Concentrations at Site Boundaries</u> |
|--------------------------------|---|--|
| Methylene Chloride | 9,700 ppb | 1.9 - 61 ppb |
| Un-ionized Ammonia-nitrogen | 11.3 ppm | 2.3 - 71 ppb |
| Formaldehyde | 40.8 ppm | 8.2 - 260 ppb |

4.2.4. QUALITATIVE ASSESSMENT OF POTENTIAL RISK

Primary exposure pathways to chemical constituents detected in ground water and soil at the Plaskon site are:

- o Soils - ingestion of or dermal contact with contaminated soils especially in those areas where the nonaqueous phase liquids were observed;
- o Ground water - ingestion of or dermal contact with ground water from wells penetrating the dolomite aquifer; and

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- o Surface water (Delaware Creek) - dermal contact with surface water by humans and direct contact and consumption by fish and aquatic organisms.

Because of the current use of the site, chronic dermal exposure or ingestion of soils is not likely; however, soils containing phthalates, methylene chloride, formaldehyde, ammonia-nitrogen and polynuclear aromatics are a potential concern if the current level of restricted access to these soil areas is not maintained in the future.

There are no health related criteria currently available for dermal exposure to soil contaminated with the organic compounds detected. However, the U.S. EPA has developed cancer potency factors for bis (2-ethylhexyl) phthalate and carcinogenic PNA compounds. Depending on the frequency and duration of exposure and average quantity of contaminated soil ingested per exposure an excess cancer risk can be calculated. The current land use at the site restricts opportunities for direct contact exposure and associated risks are considered minimal. However, if future land use at the site changes and unrestricted access to contaminated soil is allowed, then the risks associated with this direct contact may be unacceptable.

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Potential concentrations of chemical constituents in wells withdrawing water from the dolomite aquifer 800 feet away are estimated to be between 2.2 and 3.7 orders of magnitude lower than maximum concentrations found in ground water at the site. Maximum concentrations detected for ammonia-nitrogen and formaldehyde at Well GM-4 are 1130 mg/l and 40.8 mg/l, respectively. Based on the dilution analysis previously discussed, the respective off-site ranges in concentrations for ammonia-nitrogen and formaldehyde at a distance of 800 feet would be 0.23-7.1 mg/l and 8.2-260 ug/l. As noted in Section 4.2.2, almost 99 percent of the ammonia-nitrogen at GM-4 is in the ammonium (ionized) form; the expected range of concentrations for un-ionized ammonia would therefore be 2.3-71 ug/l. As discussed previously, the USEPA ambient water quality criteria for formaldehyde is 41.4 ug/l, and the World Health Organization recommended drinking water standard for un-ionized ammonia is 500 ug/l. The estimated future concentrations for un-ionized ammonia at the site boundary therefore do not represent a significant risk to human health; however, the estimated future maximum concentrations of formaldehyde at the boundary may pose an unacceptable risk to human health if ground water at the site boundaries were to be used as a drinking-water supply at a future date.

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The highest detected concentration of methylene chloride in ground water at the site (Well GM-6) is 9,700 ug/l. Using the aforementioned dilution factors, the estimated range in concentration at a distance of 800 feet is 1.9-61 ug/l. The USEPA Lifetime Health Advisory for methylene chloride is 1,750 ug/l. The estimated future concentrations for this compound in ground water at the site boundary therefore do not represent unacceptable risks to human health.

It is important to note that the water quality criteria, standards and advisories noted above refer to finished drinking water supplies only, and are therefore not necessarily appropriate from a regulatory perspective. It is also important to consider that the nearest potential ground-water receptor (water-supply well) is located 1.8 miles from the Plaskon facility. Potential future constituent concentrations at this receptor would therefore be significantly lower than those shown above (estimated concentrations at site boundaries).

Consideration must be given to the conservative nature of the assumptions used to arrive at the above calculations. Where it was necessary to select a value with a range, to estimate a value or to assume values, an effort was made to maximize transport times and minimize dilution effects. Therefore, there is a

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significant safety factor incorporated in the above calculations, but it can not be quantified.

Risk to off-site receptors associated with the presence of polynuclear aromatic hydrocarbons in the storm sewer cannot be quantified without information regarding the concentration of these compounds in the sediments and water of Delaware Creek. The presence of low levels of PNAs in streams and sediments of industrial areas is not uncommon, due primarily to particulate emissions from fossil-fuel power plants and other combustion processes.

These compounds are characterized by relatively low mobility in the ground-water environment; their transport rate relative to bulk ground-water flow velocity is therefore much lower. Consequently, the on-site presence of PNA compounds is considered to represent a low risk to off-site ground-water resources and receptors.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1. AFFECTED AREAS

Results of chemical analysis of water samples from ground-water monitor wells at the Plaskon site indicated three primary areas where shallow ground water has been impacted by previous site activities. These include the following well sites:

- o GM-4 - ammonia-nitrogen and formaldehyde at the site of a former waste settling pond where wastes containing these compounds were handled.
- o GM-6 - methylene chloride and relatively low concentrations of other volatile organics at the location of a reported methylene chloride release in Area A3.
- o GM-12 - occurrence of a non-aqueous phase liquid containing phthalates, polynuclear aromatic hydrocarbons, and some volatile organics at the

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location of reported phthalate plasticizer releases
from the Area A2 tank farm.

The horizontal and vertical extent of impacted ground water associated with these three areas are apparently limited to small areas on the plant site. The vertical and horizontal boundaries of affected ground-water are apparently within the shallow aquifer system (glacial sediments). The constituents that characterize affected ground water associated with the above three areas were not detected in the two deep dolomite aquifer monitor wells or the plant's deep wells in the dolomite aquifer.

Visual observations of liquid samples obtained from soil borings near the plasticizer tank farm area indicate the areal extent of NAPL to be 28,000 square feet (0.64 acre). The direction of NAPL movement is toward the southeast, at an estimated average transport rate of 4 feet per year.

The site investigation results indicate that methylene chloride in soil and ground water is confined to a relatively limited area around the 440 AMC plant. No evidence is available to indicate that extensive lateral or vertical movement of the compound has occurred. However, the potential exists for the methylene chloride to eventually be intercepted by the french drain system

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that encircles the Molding Compound Plant and ultimately be transported off-site via the storm sewer discharge.

Similar interpretations are applicable to the ammonia-nitrogen affected area at GM-4. Extensive lateral or vertical movement has apparently not occurred as evidenced by the non-detection of ammonia-nitrogen in the moderate or deep ground water monitoring wells at the site wells.

Transport of contaminants off-site is most likely to occur via the storm sewer system that discharges to the unnamed tributary of Delaware Creek. Delaware Creek is designated as an industrial and agricultural-use warm water stream by the Ohio EPA. Additional samples of the storm sewer system and Delaware Creek are necessary to better quantify this potential transport route.

The occurrence of relatively low concentrations of other organic compounds in some ground water samples from monitoring wells is not considered to be a significant problem. Periodic sampling should be continued.

Because minimum estimated travel times for identified constituents in ground water to migrate to the site boundaries are several decades, there currently does not appear to be a

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short term health threat from the affected ground water. Concentrations of any contaminants dissolved in ground water at the Plaskon site are estimated to be reduced 2.2 to 3.7 orders of magnitude following migration through the dolomite aquifer to the site boundary. Concentrations in ground water at the closest identified well to the site (1.8 miles) would be even lower.

5.2. ADDITIONAL DATA NEEDS

The following additional investigations are recommended:

- o Periodically sample existing monitor wells to better define the presence and concentrations of some organic compounds detected during the first two rounds of sampling.
- o Inventory the sanitary and storm sewer systems to determine if leaky sewers are transporting shallow ground water off the site.
- o Collect water samples from the storm sewer at various locations and from the tributary to Delaware Creek to

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better determine sources and concentrations of chemical
constituents being transported off site.

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TABLES

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TABLE 1

SUMMARY OF MANUFACTURING ACTIVITIES
PLASKON ELECTRONIC MATERIALS, INC.

| PLANT | PRODUCT | YEARS PRODUCED | PRINCIPAL RAW MATERIALS | |
|--|--------------------------|----------------|--|---|
| AMINO MOLDING COMPOUND PLANT | Urea-Formaldehyde MC | 1947-1983 | Urea | Melamine |
| | Melamine-Formaldehyde MC | 1947-1978 | Formaldehyde | Paper |
| <hr/> | | | | |
| 400 AMC PLANT | Alkyd MC | 1953-1978 | Polyester Resin Barium Carbonate | Asbestos Clay |
| <hr/> | | | | |
| 440 AMC PLANT | 446 Polyester | 1951 - Present | Fiberglass Polyester Resin Methylene Chloride | Clay/Mica Barium Carbonate Antimony |
| <hr/> | | | | |
| SPECIALTY MOLDING COMPOUND PLANT | Phenolic MC | 1951-1976 | Resin | |
| | Diethyl Phthalate MC | 1969-1976 | Diethyl Phthalate Antimony Oxide | Fiberglass Asbestos |
| | Epoxy MC | 1971 - Present | Epoxy Resins Phenol Novalax Hardner | Silica Alumina |
| | Plasticizers | 1951-1978 | Phthalic Anhydrides | Alcohols |
| | Alkyd Rope MC | 1971-1975 | Fiberglass Polyester Resin | Limestone |
| | Alkyd Putty | 1971-1975 | Polyester Resin Benzoyl Peroxide | Diayll Phthalate Clay |
| | Polyester Resin | 1951-1976 | Vinyl Toluene Maleic Anhydride Diayll Phthalate Monomer Ethylene Glycol Tetrachlorophthalic Anhydride | Propylene Glycol Phthallic Anhydride Styrene Adipic Acid |
| | Phenolic Resin | 1951-1976 | Ammonia High Carbon Alcohols | |
| | | | | |

TABLE 2

MONITOR WELL CONSTRUCTION INFORMATION
 MONITOR WELL DATA - PLASKON ELECTRONICS, INC.

| WELL | WELL DEPTH (Feet below land surface) | CASING DIAMETER AND TYPE | LAND SURFACE ELEVATION (Feet above sea level) | TOP OF CASING ELEVATION (Feet above sea level) | SCREENED INTERVAL (Feet below land surface) | DEPTH TO TOP OF SAND PACK (Feet below land surface) |
|--------|--|--------------------------------|--|---|--|--|
| GM-1 | 30 | 2" PVC | 625.9 | 627.41 | 20 - 30 | 7.0 |
| GM-2 | 25 | 2" PVC | 625.3 | 626.72 | 15 - 25 | 7.0 |
| GM-3 | 23 | 2" PVC | 625.3 | 627.70 | 13 - 23 | 6.5 |
| GM-4 | 25 | 2" PVC | 625.5 | 627.88 | 15 - 25 | 7.0 |
| GM-5 | 25 | 2" PVC | 625.0 | 627.09 | 15 - 25 | 7.0 |
| GM-6 | 30 | 2" PVC | 625.6 | 627.42 | 20 - 30 | 8.0 |
| GM-7S | 25 | 2" PVC | 625.3 | 627.16 | 15 - 25 | 7.0 |
| GM-7D | 86 | 4" PVC | 625.4 | 627.59 | 71 - 86* | - |
| GM-8 | 25 | 2" PVC | 624.5 | 626.07 | 15 - 25 | 6.0 |
| GM-9 | 25 | 2" PVC | 624.7 | 626.69 | 15 - 25 | 7.0 |
| GM-10 | 25 | 2" PVC | 624.7 | 626.28 | 15 - 25 | 7.0 |
| GM-11D | 84 | 4" PVC | 625.5 | 627.19 | 78 - 84* | - |
| GM-12 | 23.5 | 2" PVC | 625.4 | 627.08 | 13.5 - 23.5 | 6.0 |
| GM-13 | 24 | 2" PVC | 625.8 | 627.46 | 14 - 24 | 7.0 |
| GM-14 | 24 | 2" PVC | 624.7 | 626.74 | 14 - 24 | 7.0 |
| GM-15 | 20 | 2" PVC | 624 | 627 | 5-20 | 4 |
| PW-1 | 520 | 12" Steel | - | 625.95 | ** | - |
| PW-3 | 526 | 12" Steel | 625.3 | 626.00 | ** | - |
| PW-5 | 531 | 12" Steel | 625.3 | 627.01 | ** | - |

GM - Monitor well installed by Geraghty & Miller, March 1986

PW - Unused plant water well

* - Open borehole

** - Open boreholes from about 80 feet to well bottom

GERAGHTY & MILLER, INC.

TABLE 3A
DEPTH TO WATER IN MONITOR WELLS
PLASKON ELECTRONIC MATERIALS, INC.

DEPTH TO WATER IN MONITOR WELLS - PLASKON ELECTRONICS, INC.

Water Level Measurements -- Plaskon

| | GM-1 | GM-2 | GM-3 | GM-4 | GM-5 | GM-6 | GM-7S | GM-7D | GM-8 | GM-9 | GM-10 | GM-11D | GM-12 | GM-13 | GM-14 | PW-1 | PW-3 | PW-5 | SEWER |
|---------------------------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Land Surface Elevation | 625.9 | 625.3 | 625.3 | 625.5 | 625.0 | 625.6 | 625.3 | 625.4 | 624.5 | 624.7 | 624.7 | 625.5 | 625.4 | 625.8 | 624.7 | - | 625.3 | 625.3 | - |
| Measuring Point Elevation | 627.41 | 626.72 | 627.70 | 627.88 | 627.09 | 627.42 | 627.16 | 627.59 | 626.07 | 626.69 | 626.28 | 627.19 | 627.08 | 627.46 | 626.74 | 625.95 | 626.00 | 627.01 | 625.92 |
| Date | | | | | | | | | | | | | | | | | | | |
| 03/17/86 | 9.00 | 3.20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/18/86 | 8.79 * | 3.65 * | 5.01 * | 3.71 * | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/19/86 | - | - | - | 2.90 | 7.30 | 3.88 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/20/86 | 7.72 | 2.68 | 4.85 | 3.31 | 7.58 | 4.12 | 6.31 | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/21/86 | 7.71 | 2.97 | 4.91 | 3.51 | 7.76 | 4.25 | 6.49 | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/22/86 | 7.77 | 3.16 | 4.95 | 3.68 | 7.87 | 4.35 | 6.58 | - | 3.47 | 8.83 | - | - | - | - | - | - | - | - | - |
| 03/23/86 | 7.87 | 3.27 | 4.98 | 3.93 | 8.42 | 4.45 | 6.67 | - | 3.49 | 6.57 | 3.16 | - | - | - | - | - | - | - | - |
| 03/24/86 | 8.19 * | 3.51 | 5.09 | 4.33 * | 8.33 | 4.79 | 6.74 * | - | 3.66 | 6.45 | 3.27 | - | - | - | - | - | - | - | - |
| 03/25/86 | 7.82 | 3.61 | 5.09 | 4.27 | 8.57 * | 4.77 | 6.78 | 62.52 | 3.60 | 6.62 * | 3.29 * | - | - | - | - | - | - | - | - |
| 03/26/86 | 7.86 | 3.75 * | 5.15 | 4.41 | 8.47 | 5.06 | 6.83 | 61.99 | 3.60 | 6.73 | 3.33 | 60.67 | 5.90 | 5.89 | 4.90 | - | - | - | - |
| 03/27/86 | 7.90 | 3.85 | 6.22 * | 4.40 | 8.54 | 5.04 | 6.91 | 61.81 | 3.57 | 6.90 | 3.31 | 62.14 | 5.97 | 5.74 | 5.26 | - | - | 61.27 | - |
| 03/29/86 | 8.81 | 4.00 | 5.26 | 4.92 | 11.00 * | 5.40 | 6.99 | 61.12 | 3.64 | 7.02 | 3.45 | 61.81 | 6.04 | 5.85 | 4.86 | - | - | 60.99 | - |
| 04/03/86 | 8.01 | 4.43 | 5.42 | 5.36 | 8.79 | 5.19 | 7.21 * | 61.21 | 3.77 | 7.34 | 3.77 | 62.10 | 6.91 * | 5.91 | 5.12 | 59.15 | - | 61.18 | 19.45 |
| 09/30/86 | 7.31 | 3.45 | 5.06 | 3.65 | 7.69 | 4.16 | 7.06 | 61.08 | 3.12 | 6.46 | 2.77 | 61.77 | - | 5.80 | 4.05 | 58.86 | 59.36 | 60.92 | 19.42 |
| 10/04/86 | 4.85 | 1.81 | 4.56 | 2.67 | 6.69 | 3.40 | 5.50 | 61.07 | 2.88 | 4.79 | 2.85 | 61.07 | - | 5.49 | 3.74 | 58.20 | 59.59 | 60.70 | 19.41 |
| 11/17/86 | 8.47 | 5.16 | 6.29 | 6.37 | 9.49 | 6.53 | 8.05 | 59.68 | 4.63 | 8.31 | 4.96 | 61.19 | - | 6.35 | 6.26 | 58.95 | 59.27 | 60.39 | - |
| 02/10/87 | 8.50 | 3.32 | 4.98 | 4.59 | 8.50 | 4.94 | 6.93 | 59.36 | 3.44 | 6.60 | 3.46 | 58.31 | - | 5.85 | 4.77 | 58.13 | 58.92 | 60.02 | - |

* Water level may still be recovering from either development, bail test, or well evacuation prior to sampling.
NOTE: Well GM-15 installed 2/12/87; however, GM-15 has not yet been topographically surveyed.

GERAGHTY & MILLER, INC.

TABLE 3B

DEPTH TO WATER IN MONITOR WELLS
PLASKON ELECTRONIC MATERIALS, INC.

DEPTH TO WATER IN MONITOR WELLS - PLASKON ELECTRONICS, INC.

Water Level Measurements -- Plaskon

| | GM-1 | GM-2 | GM-3 | GM-4 | GM-5 | GM-6 | GM-7S | GM-7D | GM-8 | GM-9 | GM-10 | GM-11D | GM-12 | GM-13 | GM-14 | PW-1 | PW-3 | PW-5 | STORM SEWER |
|------------------------------|----------|----------|----------|----------|----------|--------|----------|--------|--------|----------|----------|--------|----------|--------|--------|--------|--------|--------|----------------|
| Land Surface Elevation | 625.9 | 625.3 | 625.3 | 625.5 | 625.0 | 625.6 | 625.3 | 625.4 | 624.5 | 624.7 | 624.7 | 625.5 | 625.4 | 625.8 | 624.7 | - | 625.3 | 625.3 | - |
| Measuring Point Elevation | 627.41 | 626.72 | 627.70 | 627.88 | 627.09 | 627.42 | 627.16 | 627.59 | 626.07 | 626.69 | 626.28 | 627.19 | 627.08 | 627.46 | 626.74 | 625.95 | 626.00 | 627.01 | 625.92 |
| Date | | | | | | | | | | | | | | | | | | | |
| 03/17/86 | 618.41 | 623.52 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/18/86 | 618.62 * | 623.07 * | 622.69 * | 624.17 * | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/19/86 | - | - | - | 624.98 | 619.79 | 623.54 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/20/86 | 619.69 | 624.04 | 622.85 | 624.57 | 619.51 | 623.30 | 620.85 | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/21/86 | 619.70 | 623.75 | 622.79 | 624.37 | 619.33 | 623.17 | 620.67 | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/22/86 | 619.64 | 623.56 | 622.75 | 624.20 | 619.22 | 623.07 | 620.58 | - | 622.60 | 617.86 | - | - | - | - | - | - | - | - | - |
| 03/23/86 | 619.54 | 623.45 | 622.72 | 623.95 | 618.67 | 622.97 | 620.49 | - | 622.58 | 620.12 | 623.12 | - | - | - | - | - | - | - | - |
| 03/24/86 | 619.22 * | 623.21 | 622.61 | 623.55 * | 618.76 | 622.63 | 620.42 * | - | 622.41 | 620.24 | 623.01 | - | - | - | - | - | - | - | - |
| 03/25/86 | 619.59 | 623.11 | 622.61 | 623.61 | 618.52 * | 622.65 | 620.38 | 565.07 | 622.47 | 620.07 * | 622.99 * | - | - | - | - | - | - | - | - |
| 03/26/86 | 619.55 | 622.97 * | 622.55 | 623.47 | 618.62 | 622.36 | 620.33 | 565.60 | 622.47 | 619.96 | 622.95 | 566.52 | 621.18 | 621.57 | 621.84 | - | - | - | - |
| 03/27/86 | 619.51 | 622.87 | 621.48 * | 623.48 | 618.55 | 622.38 | 620.25 | 565.78 | 622.50 | 619.79 | 622.97 | 565.05 | 621.11 | 621.72 | 621.48 | - | - | 565.74 | - |
| 03/29/86 | 618.60 | 622.72 | 622.44 | 622.96 | 616.09 * | 622.02 | 620.17 | 566.47 | 622.43 | 619.67 | 622.83 | 565.38 | 621.04 | 621.61 | 621.88 | - | - | 566.02 | - |
| 04/03/86 | 619.40 | 622.29 | 622.28 | 622.52 | 618.30 | 622.23 | 619.95 * | 566.38 | 622.30 | 619.35 | 622.51 | 565.09 | 620.17 * | 621.55 | 621.62 | 566.80 | - | 565.83 | 606.47 |
| 09/30/86 | 620.10 | 623.27 | 622.64 | 624.23 | 619.40 | 623.26 | 620.10 | 566.51 | 622.95 | 620.23 | 623.51 | 565.42 | - | 621.66 | 622.69 | 567.09 | 566.64 | 566.09 | 606.50 |
| 10/04/86 | 622.56 | 624.91 | 623.14 | 625.21 | 620.40 | 624.02 | 621.66 | 566.52 | 623.19 | 621.90 | 623.43 | 566.12 | - | 621.97 | 623.00 | 567.75 | 566.41 | 566.31 | 606.51 |
| 11/17/86 | 618.94 | 621.56 | 621.41 | 621.51 | 617.60 | 620.89 | 619.11 | 567.91 | 621.44 | 618.38 | 621.32 | 566.00 | - | 621.11 | 620.48 | 567.00 | 566.73 | 566.62 | - |
| 02/10/87 | 618.91 | 623.40 | 622.72 | 623.29 | 618.59 | 622.48 | 620.23 | 568.23 | 622.63 | 620.09 | 622.82 | 568.88 | - | 621.61 | 621.97 | 567.82 | 567.08 | 566.99 | - |

* Water level may still be recovering from either development, bail test, or well evacuation prior to sampling.
NOTE: Well GM-15 installed 2/12/87; however, GM-15 has not yet been topographically surveyed.

TABLE 4

PARAMETERS AND CONSTITUENTS ANALYZED IN WATER SAMPLES
PLASKON ELECTRONIC MATERIALS, INC.

FIRST SAMPLING ROUND - MARCH/APRIL 1986

| | |
|--------------------------------|------------------|
| pH | Chloride |
| Specific Conductance | Sulfate |
| Suspended Solids | Fluoride |
| Chemical Oxygen Demand (COD) | Phosphorus |
| Biological Oxygen Demand (BOD) | Ammonia-Nitrogen |
| Total Organic Carbon (TOC) | Nitrate-Nitrogen |
| Total Organic Halogens (TOX) | Iron |
| Oil and Grease | Manganese |
| Total Phenols (4-AAP) | Potassium |
| Foaming Agents (MBAS) | Sodium |
| 126 Priority Pollutants | Barium |
| Formaldehyde | |
| Styrene | |

SECOND SAMPLING ROUND - OCTOBER/NOVEMBER 1986

| | |
|--------------------------------------|------------------|
| Priority Pollutant Volatile Organics | Dissolved Solids |
| Priority Pollutant Phthalates | Chloride |
| Formaldehyde | Sulfate |
| Total Phenols (4-AAP) | Ammonia-Nitrogen |

- 1 - Analyses for 46 Base-Neutral Extractable Priority Pollutants were conducted on water sample (first sampling round) and two free product samples (second sampling round) from well GM-12 and sample from storm sewer.
- 2 - Sample collected from Delaware Creek (second sampling round) was not analyzed for volatile organic compounds.

105plaskon/tparamat.tbl

TABLE 5 (PAGE 1 OF 3)

RESULTS OF CHEMICAL ANALYSES - FIRST ROUND OF SAMPLING
MARCH/APRIL 1986
PLASKON ELECTRONIC MATERIALS, INC.

| | | GASOLINE TANK EXCAVATION | | | | | | | | | | | | | | | | | | | | | | | | PLANT MUNICIPAL WATER SUPPLY | |
|--------------------------------|----------|--------------------------|---------|---------|---------|--------|---------|----------------|---------|---------|---------|--------|---------|---------|------------------|---------|---------|--------|---------|---------|--------|------------|-------------|----------|----------|------------------------------|---------|
| PARAMETERS | UNITS | GM-1 | GM-2 | GM-3 | GM-4 | GM-5 | GM-6 | GM-6 DUPLICATE | GM-7D | GM-7S | GM-8 | GM-9 | GM-10 | GM-11D | GM-11D DUPLICATE | GM-12 | GM-13 | GM-14 | PW-1 | PW-3 | PW-5 | TRIP BLANK | FIELD BLANK | SAMPLE A | SAMPLE B | SAMPLE C | |
| CONDUCTIVITY @ 25 C | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CONDUCTIVITY @ 25 C | umhos/cm | 788 | 634 | 1640 | 8140 | 1270 | 1760 | 1774 | 758 | 816 | 812 | 653 | 587 | 532 | 553 | 1260 | 764 | 908 | 473 | 615 | 276 | 2.8 | 1.1 | | | | 310 |
| pH @ 25 C | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH @ 25 C | Std | 7.93 | 7.40 | 7.42 | 7.66 | 7.61 | 6.27 | 6.32 | 8.15 | 7.14 | 7.09 | 7.33 | 7.03 | 7.42 | 7.56 | 6.6 | 7.2 | 7.18 | 7.22 | 7.36 | 8.05 | 6.20 | 6.35 | | | | 8.60 |
| SUSPENDED SOLIDS | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUSPENDED SOLIDS | mg/l | 378 | 1510 | 1790 | 94 | 2540 | 170 | 1460 | 28800 | 2100 | 269 | 1080 | 1330 | 767 | 613 | 4280 | 1460 | 1080 | 19 | 55 | 36 | < 1 | < 1 | | | | < 1 |
| BIOLOGICAL OXYGEN DEMAND (BOD) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BIOLOGICAL OXYGEN DEMAND (BOD) | mg/l | 6 | 3 | < 1 | 10 | 2 | GT 196 | GT 202 | 13 | 2 | 1 | < 1 | < 1 | 3 | 5 | 21 | < 1 | 1 | < 1 | < 1 | 1 | < 1 | < 1 | | | | < 1 |
| CHEMICAL OXYGEN DEMAND (COD) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHEMICAL OXYGEN DEMAND (COD) | mg/l | 51 | 230 | 95 | 142 | 54 | 831 | 851 | 1430 | 67 | 35 | 40 | 20 | 69 | 66 | 257 | 42 | 165 | 17 | 15 | 24 | < 5 | < 5 | | | | 8 |
| TOTAL ORGANIC CARBON (TOC) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL ORGANIC CARBON (TOC) | mg/l | 17 | 30 | 24 | 31 | 18 | 348 | 350 | 227 | 22 | 10 | 14 | 9 | 18 | 16 | 65 | 14 | 33 | 4 | 4 | 7 | < 1 | < 1 | | | | 6 |
| TOTAL ORGANIC HALOGENS (TOX) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL ORGANIC HALOGENS (TOX) | mg/l | <0.01 | <0.01 | <0.01 | 0.43 | <0.01 | 160 | 150 | 0.15 | <0.01 | 0.02 | <0.01 | 0.01 | 0.04 | 0.12 | 0.79 | 0.01 | 0.76 | 0.03 | 0.56 | 0.07 | <0.01 | <0.01 | | | | 0.14 |
| SURFACTANTS (MBAS) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SURFACTANTS (MBAS) | mg/l | <0.02 | <0.02 | <0.02 | 0.1 | <0.02 | 9.97 | 7.92 | <0.02 | <0.02 | 0.18 | <0.02 | 0.1 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | <0.02 | <0.02 | | | | 0.12 |
| OIL & GREASE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OIL & GREASE | mg/l | 2.2 | 2.4 | 1.8 | 2.3 | 1.5 | 11.6 | 11.2 | 1.2 | <0.5 | <0.5 | <0.5 | <0.5 | 3.9 | 3.5 | 28.2 | 2 | 0.8 | 3.3 | 3.1 | 1.7 | <0.5 | 0.9 | | | | <0.5 |
| TOTAL PHENOLS (4-AAP) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL PHENOLS (4-AAP) | mg/l | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.007 | 0.049 | <0.005 | <0.005 | <0.005 | <0.005 | 0.009 | 0.011 | <0.005 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | | | | <0.005 |
| INORGANICS AND METALS | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHLORIDE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHLORIDE | mg/l | 13.1 | 9.4 | 27.7 | 49.2 | 196 | 280 | 1680 | 5.3 | 3.5 | 12.6 | 6.4 | 5.3 | 4.6 | 4.1 | 25.1 | 23.8 | 61 | 2.6 | 22.2 | 5.5 | < 1 | < 1 | | | | 24.8 |
| CYANIDE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CYANIDE | mg/l | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | | | | <0.004 |
| FLUORIDE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FLUORIDE | mg/l | 0.3 | 0.27 | 0.26 | 0.68 | 0.32 | 0.13 | 0.14 | 1.62 | 0.15 | 0.21 | 0.32 | 0.21 | 1.5 | 1.5 | 0.18 | 0.14 | 0.3 | 1.1 | 0.61 | 1.12 | <0.1 | <0.1 | | | | 0.97 |
| PHOSPHORUS | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PHOSPHORUS | mg/l | 0.35 | 3.12 | 1.46 | 0.22 | 0.6 | 0.17 | 1.2 | 10.9 | 2.26 | 0.3 | 0.45 | 0.26 | 0.4 | 0.4 | 1.86 | 0.5 | 3.19 | 1.39 | 0.08 | 0.08 | 0.02 | 0.02 | | | | 0.11 |
| SULFATE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SULFATE | mg/l | 72 | 58 | 450 | 346 | 93 | 21 | 16 | 289 | 146 | 46 | 54 | 39 | 134 | 136 | 13 | 45 | 86 | 114 | 67 | 25 | 4 | 6 | | | | 47 |
| AMMONIA - NITROGEN | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AMMONIA - NITROGEN | mg/l | 0.1 | <0.1 | 0.25 | 996 | 0.34 | 0.28 | 0.33 | 0.51 | 0.26 | 0.18 | 0.23 | 0.22 | 0.2 | 0.28 | 0.25 | 0.2 | 0.2 | 0.17 | 0.24 | <0.10 | <0.10 | <0.10 | | | | 0.18 |
| NITRATE - NITROGEN | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NITRATE - NITROGEN | mg/l | 1.66 | 1.20 | 0.14 | 9.48 | 5.05 | 0.07 | 0.04 | 0.59 | 0.5 | 0.15 | 0.92 | 0.05 | 0.23 | 0.18 | 0.38 | 1.83 | 0.35 | 0.15 | 0.44 | 0.93 | <0.02 | <0.02 | | | | 2.99 |
| ANTIMONY | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ANTIMONY | mg/l | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.014 | 0.015 | 0.003 | <0.002 | <0.002 | <0.002 | <0.002 | 0.005 | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | | | | <0.002 |
| ARSENIC | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARSENIC | mg/l | <0.004 | <0.004 | <0.004 | 0.021 | <0.004 | 0.022 | 0.025 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | 0.005 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | | | | <0.004 |
| BARIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BARIUM | mg/l | <0.5 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | <0.5 |
| BERYLLIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BERYLLIUM | mg/l | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | | | <0.005 |
| CADMIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CADMIUM | mg/l | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | | | | <0.002 |
| CHROMIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHROMIUM | mg/l | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | | | | <0.002 |
| COPPER | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| COPPER | mg/l | 0.008 | 0.011 | 0.008 | 0.009 | 0.008 | 0.008 | 0.009 | 0.01 | 0.012 | 0.006 | 0.01 | 0.006 | 0.007 | 0.008 | 0.012 | 0.004 | 0.006 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | | | | 0.006 |
| IRON | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IRON | mg/l | 0.02 | 0.03 | 0.01 | 0.11 | 0.07 | 67.5 | 58.4 | 0.64 | 0.36 | 0.06 | 0.03 | 0.97 | 0.12 | 0.17 | 0.03 | 0.79 | 0.079 | 0.07 | 0.099 | 0.07 | 0.02 | 0.04 | | | | 0.03 |
| LEAD | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LEAD | mg/l | 0.004 | 0.004 | 0.004 | 0.004 | 0.005 | <0.004 | 0.004 | 0.004 | 0.004 | <0.004 | 0.005 | <0.004 | <0.004 | <0.004 | <0.004 | 0.005 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | | | | 0.005 |
| MANGANESE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MANGANESE | mg/l | 0.081 | 0.232 | 0.301 | 0.132 | 0.113 | 4.3 | 4.1 | 0.025 | 0.054 | 1.04 | 0.166 | 0.624 | 0.014 | 0.014 | 3.63 | 0.054 | 0.12 | 0.032 | 0.046 | 0.090 | <0.010 | <0.010 | | | | <0.010 |
| MERCURY | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MERCURY | mg/l | <0.0002 | <0.0002 | <0.0002 | <0.0002 | 0.0005 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | | | | <0.0002 |
| NICKEL | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NICKEL | mg/l | <0.002 | 0.002 | 0.003 | 0.022 | 0.008 | <0.002 | <0.002 | 0.004 | 0.006 | 0.004 | 0.004 | 0.007 | 0.003 | 0.002 | <0.002 | 0.003 | <0.002 | 0.002 | 0.002 | 0.002 | <0.002 | <0.002 | | | | 0.002 |
| POTASSIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| POTASSIUM | mg/l | 2.94 | 1.71 | 5 | 13.8 | 5.52 | 3.62 | 3.53 | 17.7 | 1.98 | 1.13 | 8.1 | 1.44 | 10.7 | 9.76 | 1.64 | 0.89 | 3.27 | 2.27 | 3.02 | 1.32 | 0.11 | 0.18 | | | | 2.40 |
| SELENIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SELENIUM | mg/l | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 | | | | <0.008 |
| SILVER | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SILVER | mg/l | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.011 | 0.01 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.010 | 0.010 | <0.010 | <0.010 | | | | <0.010 |
| SODIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SODIUM | mg/l | 41.3 | 10.4 | 31.2 | 88.8 | 104 | 19.7 | 20.3 | 61.1 | 10.2 | 36.2 | 16.6 | 19.6 | 64.2 | 61.5 | 38.9 | 19.6 | 45.2 | 43.7 | 26.1 | 48.1 | 0.41 | 0.72 | | | | 22.1 |
| THALLIUM | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| THALLIUM | mg/l | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | | <0.02 |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |

TABLE 5 (PAGE 2 OF 3)

| PARAMETERS | UNITS | GM-1 | GM-2 | GM-3 | GM-4 | GM-5 | GM-6 | | GM-7D | GM-7S | GM-8 | GM-9 | GM-10 | GM-11D | | GM-12 | GM-13 | GM 14 | PW-1 | PW-3 | PW-5 | TRIP BLANK | FIELD BLANK | GASOLINE TANK EXCAVATION | | | PLANT MUNICIPAL WATER SUPPLY | |
|-------------------------------|-------|------|------|------|------|------|---------|-----------|-------|-------|------|------|-------|--------|-----------|-------|-------|-------|-------|-------|-------|---------------|----------------|-----------------------------|----------|----------|---------------------------------------|------|
| | | | | | | | GM-6 | DUPLICATE | | | | | | GM-11D | DUPLICATE | | | | | | | | | SAMPLE A | SAMPLE B | SAMPLE C | | |
| CHLOROETHANE | ug/l | <0.8 | < 1 | < 2 | <0.7 | < 1 | < 1 | <1 | < 2 | < 1 | <0.8 | <0.6 | <0.9 | < 2 | < 1 | < 2 | <0.9 | < 1 | < 1 | < 0.8 | < 0.8 | < 1 | < 1 | < 1 | <0.8 | <0.7 | <0.9 | <0.9 |
| 2-CHLOROETHYL VINYL ETHER | ug/l | <10 | <10 | <20 | < 9 | <10 | <20 | <10 | <20 | <10 | <10 | < 8 | <10 | <30 | <20 | <20 | <10 | <10 | <10 | <10 | <10 | <10 | <20 | <10 | <0.8 | <0.7 | <10 | <0.9 |
| CHLOROFORM | ug/l | <0.4 | <0.4 | <0.7 | <0.3 | <0.5 | 3.3 | 1.9 | <0.9 | 0 | <0.4 | <0.3 | <0.4 | <0.9 | <0.6 | <0.8 | <0.4 | <0.5 | <0.5 | <0.4 | <0.4 | 21 | 0.64 | <0.4 | <0.3 | <0.4 | 52 | |
| DICHLOROBROMOMETHANE | ug/l | <0.6 | <0.4 | <0.7 | <0.7 | <0.6 | < 1 | < 1 | <0.8 | <1.0 | <0.6 | <0.5 | <0.7 | <0.9 | < 0.8 | <0.7 | <0.6 | < 1 | < 0.8 | < 0.9 | < 0.9 | 5.0 | <0.8 | <0.6 | <0.5 | <0.7 | 9.2 | |
| 1,1-DICHLOROETHANE | ug/l | < 1 | < 1 | < 2 | <0.8 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | <0.8 | < 1 | < 2 | < 2 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 | <2 | <1 | <0.9 | <1 | <1 | |
| 1,2-DICHLOROETHANE | ug/l | <0.5 | <0.5 | <0.9 | <0.4 | <0.6 | <0.7 | <0.6 | < 1 | <0.6 | <0.5 | <0.4 | <0.5 | < 1 | <0.7 | <1.0 | <0.5 | <0.6 | <0.6 | <0.5 | <0.5 | <0.6 | <0.7 | <0.5 | <0.7 | <0.5 | <0.5 | |
| 1,1,-DICHLOROETHYLENE | ug/l | < 1 | < 1 | < 2 | <0.8 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | <0.8 | < 1 | < 2 | < 2 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | <1 | <0.9 | <1 | <0.5 | |
| 1,2-DICHLOROPROPANE | ug/l | <0.8 | <0.5 | <0.9 | <0.9 | <0.8 | < 1 | <1 | < 1 | < 1 | <0.8 | <0.7 | <0.9 | < 1 | <1 | <1.0 | <0.9 | <1 | <1 | <1 | <1 | <0.09 | <1 | <0.8 | <0.7 | <0.9 | <1 | |
| CIS-1,3-DICHLOROPROPENE | ug/l | <0.8 | <0.5 | <0.9 | <0.8 | <0.8 | < 1 | <1 | < 1 | < 1 | <0.7 | <0.7 | <0.9 | < 1 | <1 | <0.9 | <0.8 | <1 | <1 | <1 | <1 | <0.09 | <1 | <0.7 | <0.6 | <0.9 | <1 | |
| TRANS-1,3-DICHLOROPROPENE | ug/l | <0.8 | <0.5 | < 1 | <0.9 | <0.9 | < 1 | < 1 | < 1 | < 1 | <0.8 | <0.8 | <1.0 | < 1 | < 1 | < 1 | < 0.9 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | <0.8 | <0.7 | <1.0 | <1.0 | |
| ETHYL BENZENE | ug/l | <0.7 | <0.8 | < 2 | < 1 | <0.9 | < 1 | < 1 | < 3 | < 2 | <0.9 | <0.9 | < 1 | < 1 | < 1 | < 1 | < 0.9 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | <0.8 | <0.7 | <1.0 | <1.0 | |
| METHYL BROMIDE | ug/l | <0.7 | <0.8 | < 1 | <0.5 | <0.8 | < 1 | <0.8 | < 2 | <0.9 | <0.7 | <0.5 | <0.7 | < 2 | < 1 | < 1 | < 0.8 | < 0.9 | < 0.9 | < 0.9 | < 1 | < 0.09 | < 1 | 2.6 | 2.3 | 7.2 | <0.9 | |
| METHYL CHLORIDE | ug/l | <0.8 | < 1 | < 2 | <0.7 | < 1 | < 1 | < 1 | < 2 | < 1 | <0.8 | <0.6 | <0.9 | < 2 | < 1 | < 2 | < 0.9 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | <0.7 | <0.6 | <0.8 | <0.8 | |
| METHYLENE CHLORIDE | ug/l | <0.9 | < 1 | 82 | <0.7 | < 1 | 3,200 | 4500 | < 2 | <0.7 | <0.9 | <0.7 | <0.9 | < 2 | <1 | < 2 | < 1.0 | < 1.0 | <1 | <0.8 | <0.9 | 7.7 | <1 | <0.9 | 40 | <1.0 | <0.9 | |
| Sym-TETRACHLOROETHANE | ug/l | <0.7 | <0.8 | < 2 | < 1 | <0.9 | < 1 | < 1.0 | < 3 | < 2 | <0.9 | <0.9 | < 1 | < 1 | < 1.0 | < 1 | < 0.9 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | <0.9 | <0.9 | <0.7 | <0.7 | <0.7 | <0.8 | |
| TETRACHLOROETHYLENE | ug/l | <0.8 | <0.9 | < 3 | < 2 | < 1 | < 2 | <1 | < 3 | < 2 | < 1 | < 1 | < 1 | < 2 | <1 | < 2 | < 1 | < 2 | <1 | <1 | <2 | <1 | <1 | <0.8 | <0.9 | <0.9 | <1 | |
| TOLUENE | ug/l | <0.6 | <0.6 | < 2 | < 1 | <0.7 | < 1 | <0.8 | < 2 | < 1 | <0.7 | <0.7 | <0.9 | < 1 | <0.8 | < 1 | < 0.7 | < 1 | <0.8 | <0.9 | <1 | 2.1 | <0.7 | 590 | 550 | 770 | <0.7 | |
| 1,2-T-DICHLOROETHYLENE | ug/l | <0.8 | < 1 | < 2 | <0.7 | < 1 | 5.2 | 3 | < 2 | < 1 | <0.8 | <0.6 | <0.9 | < 2 | <1 | < 2 | < 0.9 | < 1 | <1 | <0.8 | <0.8 | <1 | <1 | <0.8 | <0.7 | <0.9 | <0.9 | |
| 1,1,1-TRICHLOROETHANE | ug/l | <0.5 | <0.6 | <0.9 | <0.4 | <0.6 | <0.7 | < 0.6 | < 1 | <0.6 | <0.5 | <0.4 | <0.5 | < 1 | < 0.7 | < 1 | < 0.6 | < 0.6 | < 0.6 | < 0.5 | < 0.5 | < 0.6 | < 0.8 | <0.8 | <0.7 | <0.9 | <0.9 | |
| 1,1,2-TRICHLOROETHANE | ug/l | < 1 | <0.8 | < 1 | < 1 | < 1 | < 2 | < 2 | < 2 | < 2 | < 1 | < 1 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 2 | < 1 | < 2 | <1 | <0.4 | <0.5 | <0.5 | |
| TRICHLOROETHYLENE | ug/l | < 1 | <0.6 | < 1 | < 1 | < 1 | < 2 | < 2 | < 1 | < 2 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 2 | <1 | <1 | <1 | <2 | |
| TRICHLOROFLUOROMETHANE | ug/l | <0.5 | <0.6 | < 1 | <0.4 | <0.7 | <0.8 | < 0.6 | < 1 | <0.7 | <0.5 | <0.4 | <0.6 | < 1 | < 0.8 | < 1 | < 0.6 | < 0.7 | < 0.7 | < 0.5 | < 0.5 | < 0.7 | < 0.8 | <0.5 | <0.4 | <0.6 | <0.6 | |
| VINYL CHLORIDE | ug/l | <0.8 | <0.9 | < 1 | <0.6 | <0.9 | < 1 | 2.3 | < 2 | < 1 | <0.8 | <0.6 | <0.8 | < 2 | <1 | < 2 | < 0.9 | < 1.0 | <1 | <0.7 | <0.7 | <0.9 | <1 | < 0.8 | < 0.6 | < 0.8 | < 0.9 | |
| ACID - EXTRACTABLES | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-CHLOROPHENOL | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 3 | < 3 | < 2 | < 2 | < 3 | < 2 | < 1 | < 3 | < 1 | < 1 | < 7 | < 3 | < 2 | < 6 | < 1 | < 7 | | | | <2 | |
| 2,4-DICHLOROPHENOL | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <20 | < 3 | < 3 | < 2 | < 1 | < 3 | < 2 | < 1 | < 3 | < 3 | < 1 | < 7 | < 3 | < 2 | < 6 | < 1 | < 7 | | | | <2 | |
| 2,4-DIMETHYLPHENOL | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 3 | < 3 | < 2 | < 1 | < 2 | < 2 | < 1 | < 3 | < 2 | < 1 | < 6 | < 2 | < 2 | < 5 | < 1 | < 6 | | | | <2 | |
| 4,6-DINITRO-O-CRESOL | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <200 | < 40 | < 8 | < 5 | < 5 | < 8 | < 6 | < 3 | < 9 | < 6 | < 4 | < 20 | < 8 | < 7 | < 20 | < 3 | < 20 | | | | <6 | |
| 2,4-DINITROPHENOL | ug/l | < 5 | < 5 | < 5 | < 5 | < 5 | <100 | < 30 | <10 | < 7 | < 6 | <10 | < 7 | < 5 | < 10 | < 8 | < 5 | < 30 | < 10 | < 10 | < 20 | < 5 | < 30 | | | | <8 | |
| 2-NITROPHENOL | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <20 | < 4 | < 4 | < 3 | < 2 | < 4 | < 3 | < 2 | < 5 | < 3 | < 2 | < 10 | < 4 | < 4 | < 8 | < 2 | < 10 | | | | <3 | |
| 4-NITROPHENOL | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <30 | < 5 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 5 | < 3 | < 3 | < 4 | < 3 | < 5 | | | | <3 | |
| P-CHLORO-M-CRESOL | ug/l | < 2 | < 2 | < 2 | < 1 | < 2 | <30 | <8 | < 4 | < 3 | < 3 | < 5 | < 4 | < 1 | <5 | <10 | <2 | <10 | <5 | <4 | <9 | <1 | <10 | | | | <4 | |
| PENTACHLOROPHENOL | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <800 | < 90 | <10 | < 6 | < 5 | < 8 | < 6 | < 3 | < 10 | < 7 | < 4 | < 20 | < 9 | < 8 | < 20 | < 3 | < 20 | | | | <6 | |
| PHENOL | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 2 | 35 | < 1 | < 1 | < 2 | < 2 | < 1 | < 2 | < 1 | < 1 | < 5 | < 2 | < 2 | 8.7 | <1 | <5 | | | | <2 | |
| 2,4,6-TRICHLOROPHENOL | ug/l | < 1 | < 1 | < 2 | < 1 | < 1 | <40 | <9 | < 5 | < 3 | < 3 | < 4 | < 3 | < 1 | <5 | <20 | <2 | <10 | <5 | <4 | <10 | <2 | <10 | | | | <3 | |
| BASE-NEUTRAL EXTRACTABLES | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACENAPHTHENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | < 8 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | | | | <1 | |
| ACENAPHTHYLENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | < 6 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 2 | | | | <1 | |
| ANTHRACENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <90 | < 10 | 2.5 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | | | | <1 | |
| BENZIDINE | ug/l | <20 | <30 | <30 | <20 | <30 | <10,000 | <1000 | <1000 | <60 | <80 | <60 | <20 | <100 | <200 | <40 | <200 | <40 | <90 | <80 | <200 | <40 | <200 | <60 | | | | <60 |
| BENZO (a) ANTHRACENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <40 | < 4 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 3 | | | | <1 | |
| BENZO (a) PYRENE | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <30 | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 3 | < 2 | < 2 | < 2 | < 2 | < 3 | | | | <2 | |
| 3,4-BENZOFLUORANTHENE | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <20 | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | | | | <2 | |
| BENZO (ghi) PERYLENE | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | < 8 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 8 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | | | | <3 | |
| BENZO (k) FLUORANTHENE | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <20 | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 3 | < 2 | < 2 | < 2 | < 2 | < 3 | | | | <2 | |
| Bis (2-CHLOROETHOXYMETHANE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | < 6 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 3 | < 1 | < 1 | < 2 | < 1 | < 3 | | | | <1 | |
| Bis (2-CHLOROETHYL) ETHER | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 5 | < 2 | < 2 | < 4 | < 1 | < 5 | | | | <2 | |
| Bis (2-CHLOROISOPROPYL) ETHER | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <30 | < 5 | < 5 | < 3 | < 2 | < 3 | < 2 | < 1 | < 6 | < 3 | < 2 | < 10 | < 5 | < 5 | < 10 | < 2 | < 10 | | | | <2 | |
| Bis (2-ETHYLHEXYL)PHTHALATE | ug/l | 20 | 21 | 73 | 34 | 4.7 | <60 | 15 | 24 | 1.2 | 1.7 | < 2 | 1.5 | 8.5 | 14 | 3,700 | 4 | | | | | | | | | | | |

TABLE 5 (PAGE 3 OF 3)

| PARAMETERS | UNITS | GM-1 | GM-2 | GM-3 | GM-4 | GM-5 | GM-6 | GM-7 | GM-8 | GM-9 | GM-10 | GM-11 | GM-12 | GM-13 | GM-14 | PW-1 | PW-3 | PW-5 | TRIP BLANK | FIELD BLANK | SAMPLE A | SAMPLE B | SAMPLE C | WATER SUPPLY |
|-----------------------------|-------|------|------|------|------|------|--------|------|------|------|-------|-------|-------|-------|-------|------|------|------|------------|-------------|----------|----------|----------|--------------|
| CHRYSENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <40 | < 4 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | <1 |
| DIBENZO (a,h) ANTHRACENE | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | < 9 | < 4 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 9 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 4 | <3 |
| 1,2-DICHLOROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 5 | < 2 | < 2 | < 4 | < 1 | < 5 | <1 |
| 1,3-DICHLOROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | < 9 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 5 | < 2 | < 2 | < 4 | < 1 | < 5 | <1 |
| 1,4-DICHLOROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 2 | < 3 | < 2 | < 1 | < 3 | < 2 | < 1 | < 3 | < 1 | < 1 | < 6 | < 3 | < 2 | < 5 | 1.1 | <6 | <2 |
| 3,3'-DICHLOROBENZINDINE | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <90 | < 9 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 4 | < 3 | < 5 | < 3 | < 3 | < 4 | < 3 | < 3 | < 5 | <3 |
| DIETHYL PHTHALATE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <90 | < 20 | < 4 | < 3 | < 2 | < 4 | < 2 | < 1 | < 4 | < 3 | < 2 | < 10 | < 4 | < 3 | < 8 | < 1 | < 10 | <3 |
| DIMETHYL PHTHALATE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 3 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 3 | < 1 | < 1 | < 2 | < 1 | < 3 | <1 |
| DI-n-BUTYL PHTHALATE | ug/l | 1.8 | 1.3 | < 1 | 3 | < 1 | <90 | < 10 | 4.9 | < 1 | < 1 | < 1 | < 1 | 1.4 | 1.6 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | <1 |
| 2,4-DINITROTOLUENE | ug/l | < 5 | < 5 | < 5 | < 5 | < 5 | <90 | < 20 | < 6 | < 5 | < 5 | < 5 | < 5 | < 5 | < 6 | < 5 | < 5 | < 10 | < 6 | < 5 | < 10 | < 5 | < 10 | <1 |
| 2,6-DINITROTOLUENE | ug/l | < 5 | < 5 | < 5 | < 5 | < 5 | <50 | < 10 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 6 | < 5 | < 5 | < 10 | < 6 | < 5 | < 10 | < 5 | < 10 | <1 |
| DI-n-OCTYL PHTHALATE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | 5.7 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 |
| 1,2-DIPHENYLHYDRAZINE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <20 | < 3 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | <1 |
| FLUORANTHENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <100 | < 10 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 2 | <1 |
| FLUORENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <20 | < 3 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 2 | <1 |
| HEXACHLOROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <100 | < 20 | < 3 | < 2 | < 1 | < 2 | < 1 | < 1 | < 3 | < 2 | < 1 | < 6 | < 2 | < 2 | < 5 | < 1 | < 6 | <2 |
| HEXACHLOROBUTADIENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <20 | < 4 | < 4 | < 2 | < 2 | < 3 | < 2 | < 1 | < 4 | < 3 | < 1 | < 9 | < 4 | < 3 | < 7 | < 1 | < 9 | <2 |
| HEXACHLOROCYCLOPENTADIENE | ug/l | < 2 | < 2 | < 3 | < 2 | < 2 | <60 | <10 | < 8 | < 5 | < 4 | < 7 | < 5 | < 1 | <8 | <30 | <3 | <20 | <8 | <7 | <20 | <2 | <20 | <5 |
| HEXACHLOROETHANE | ug/l | < 2 | < 2 | < 2 | < 1 | < 2 | <30 | < 5 | < 5 | < 3 | < 3 | < 5 | < 3 | < 1 | < 6 | < 2 | < 2 | < 10 | < 5 | < 4 | < 10 | < 2 | < 10 | <5 |
| INDENO (123-cd) PYRENE | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | < 9 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 8 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 4 | <4 |
| ISOPHORONE | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | < 7 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 2 | < 3 | < 2 | < 4 | <3 |
| NAPHTHALENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | < 4 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | 3.0 | <2 | <1 |
| NITROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 2 | < 1 | < 1 | < 5 | < 2 | < 2 | < 4 | < 1 | < 5 | <2 |
| N-NITROSO-DIMETHYLAMINE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <10 | < 3 | < 3 | < 2 | < 1 | < 2 | < 2 | < 1 | < 3 | < 1 | < 1 | < 6 | < 3 | < 2 | < 5 | < 1 | < 7 | <2 |
| N-NITROSO-DI-n-PROPYLAMINE | ug/l | < 4 | < 4 | < 4 | < 3 | < 4 | <60 | <10 | <10 | < 8 | < 7 | <10 | < 8 | < 2 | <10 | < 6 | < 5 | < 30 | <10 | <10 | < 30 | < 5 | < 30 | <9 |
| N-NITROSO-DIPHENYLAMINE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <70 | <10 | < 3 | < 2 | < 1 | < 3 | < 2 | < 1 | < 3 | < 2 | < 1 | < 7 | < 3 | < 2 | < 6 | < 1 | < 7 | <2 |
| PHENANTHRENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <60 | < 7 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 2 | <1 |
| PYRENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <80 | < 7 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 |
| 1,2,4-TRICHLOROBENZENE | ug/l | < 1 | < 1 | < 1 | < 1 | < 1 | <20 | < 4 | < 3 | < 2 | < 2 | < 3 | < 2 | < 1 | < 3 | < 3 | < 1 | < 3 | < 3 | < 2 | < 6 | < 1 | < 7 | <2 |
| PESTICIDES AND PCB'S | | | | | | | | | | | | | | | | | | | | | | | | |
| ALDRIN | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <1000 | <100 | < 9 | < 6 | < 5 | < 8 | < 6 | < 3 | <10 | <20 | < 4 | <20 | < 9 | < 8 | <20 | < 3 | <20 | <6 |
| A-BHC | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <200 | <40 | < 7 | < 4 | < 3 | < 6 | < 4 | < 2 | < 7 | < 4 | < 3 | <20 | < 6 | < 5 | <10 | < 3 | <20 | <4 |
| B-BHC | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <200 | <50 | < 6 | < 3 | < 3 | < 4 | < 3 | < 3 | < 5 | < 4 | < 3 | <10 | < 4 | < 4 | < 9 | < 3 | <10 | <3 |
| G-BHC (LINDANE) | ug/l | < 4 | < 4 | < 5 | < 4 | < 4 | <700 | <200 | < 9 | < 7 | < 7 | <10 | < 9 | < 3 | <20 | <10 | < 6 | <40 | <10 | <10 | < 30 | < 5 | <40 | <10 |
| D-BHC | ug/l | < 4 | < 4 | < 4 | < 4 | < 4 | <600 | <80 | <10 | < 5 | < 4 | < 7 | < 5 | < 4 | < 8 | < 6 | < 4 | <20 | < 8 | < 7 | <20 | < 4 | <20 | <5 |
| CHLORDANE | ug/l | <10 | <10 | <10 | <10 | <10 | <2,000 | <200 | <10 | <10 | <10 | <20 | <10 | <10 | <20 | < 40 | <10 | <40 | <20 | <10 | < 30 | <10 | <40 | <10 |
| 4,4'-DDD | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <60 | <10 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 2 | < 5 | < 2 | < 2 | < 4 | < 2 | < 5 | <10 |
| 4,4'-DDE | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <300 | <70 | <10 | < 6 | < 5 | < 9 | < 6 | < 3 | <10 | <10 | < 4 | <20 | <10 | < 8 | <20 | < 4 | <20 | <2 |
| 4,4'-DDT | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <200 | <30 | < 7 | < 4 | < 3 | < 6 | < 4 | < 3 | <10 | < 4 | < 3 | <20 | < 7 | < 6 | <10 | < 2 | <20 | <3 |
| DIELDRIN | ug/l | < 2 | < 2 | < 2 | < 2 | < 2 | <200 | <30 | < 5 | < 2 | < 2 | < 3 | < 2 | < 2 | < 5 | < 6 | < 2 | < 9 | < 4 | < 3 | < 8 | < 2 | <10 | <4 |
| ENDOSULFAN I | ug/l | <10 | <10 | <20 | <10 | <10 | <4,000 | <500 | <60 | <30 | <30 | <40 | <30 | <10 | <50 | <100 | <20 | <100 | <50 | <40 | <100 | <20 | <100 | <30 |
| ENDOSULFAN II | ug/l | <10 | <10 | <10 | <10 | <10 | <700 | <100 | <30 | <20 | <10 | <30 | <20 | <10 | <40 | <30 | <10 | <70 | <30 | <20 | <60 | <10 | <70 | <20 |
| ENDOSULFAN SULFATE | ug/l | < 7 | < 7 | < 7 | < 7 | < 7 | <400 | <90 | <20 | <10 | <10 | <20 | <10 | < 9 | <40 | <10 | < 8 | <50 | <20 | <20 | <40 | < 7 | <50 | <10 |
| ENDRIN | ug/l | <20 | <20 | <20 | <20 | <20 | <1,000 | <400 | <80 | <40 | <40 | <60 | <40 | <20 | <100 | <80 | <30 | <200 | <70 | <60 | <100 | <30 | <200 | <50 |
| HEPTACHLOR | ug/l | < 5 | < 6 | < 7 | < 5 | < 6 | <1,000 | <300 | <20 | <10 | <10 | <20 | <10 | < 5 | <20 | <20 | < 9 | <50 | <20 | <20 | <40 | < 8 | <50 | <10 |
| HEPTACHLOR EPOXIDE | ug/l | < 5 | < 6 | < 7 | < 5 | < 6 | <2,000 | <300 | <20 | <10 | <10 | <20 | <10 | < 5 | <30 | <50 | < 9 | <60 | <20 | <20 | <50 | < 9 | <60 | <20 |
| TOXAPHENE | ug/l | <10 | <10 | <10 | <10 | <10 | <600 | <90 | <20 | <10 | <10 | <20 | <10 | <10 | <40 | <10 | <10 | <50 | <20 | <20 | <40 | <10 | <50 | <10 |
| ENDRIN ALDEHYDE | ug/l | < 7 | < 7 | < 7 | < 7 | < 7 | <500 | <90 | <20 | <10 | <10 | <20 | <10 | < 8 | <30 | <10 | < 8 | <50 | <20 | <20 | <40 | < 7 | <50 | <10 |
| TETRACHLORODIBENZO-P-DIOXIN | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <200 | <30 | < 6 | < 4 | < 3 | < 6 | < 4 | < 3 | <10 | < 4 | < 3 | <20 | < 6 | < 5 | <10 | < 3 | <20 | <4 |
| PESTICIDES AND PCB'S | | | | | | | | | | | | | | | | | | | | | | | | |
| PCB-1016 | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <400 | <40 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 7 | < 3 | < 3 | < 6 | < 3 | < 7 | <3 |
| PCB-1221 | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <90 | <10 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 3 | < 5 | < 3 | < 3 | < 4 | < 3 | < 5 | <3 |
| PCB-1232 | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <500 | <60 | < 5 | < 3 | < 3 | < 4 | < 3 | < 3 | < 4 | < 3 | < 3 | <10 | < 4 | < 4 | < 8 | < 3 | <10 | <3 |
| PCB-1242 | ug/l | < 3 | < 3 | < 3 | < 3 | < 3 | <400 | <50 | < 4 | < 3 | < 3 | < 3 | < 3 | < 3 | < 4 | < 3 | < 3 | < 8 | < 3 | < 3 | < 6 | < 3 | < 8 | <3 |
| PCB-1248 | ug/l | < 4 | < 4 | < 4 | < 4 | < 4 | <400 | <40 | < 4 | < 4 | < 4 | < 4 | < 4 | < 4 | < 4 | < | | | | | | | | |

Field Blank - distilled water sample transferred directly into sample bottle.

Trip Blank - distilled water sample exposed to sampling processes.

TABLE 6 (PAGE 1 OF 2)

RESULTS OF CHEMICAL ANALYSES - SECOND ROUND OF SAMPLING
OCTOBER/NOVEMBER 1986
PLASKON ELECTRONIC MATERIALS, INC.

PLASKON TESTING RESULTS

| PLASKON TESTING RESULTS | | | | | | | | | | | | | | | | | | | | | | (5) | | (1) | | (2) | | (3) | | (4) | | PLANT |
|-------------------------|-------|--------|------|-------|-------|-------------------|-------|-------|-------|---------|-------|-------|-------|--------|---------------------|---------|---------------|-----------------|-------|-------|--------|---------|---------|---------------------------|-------------------------------|---------------------------------|---------------|----------------|------------------------------|-----|--|-------|
| PARAMETER | UNITS | GM-1 | GM-2 | GM-3 | GM-4 | GM-4 DUPLICATE | GM-5 | GM-6 | GM-7S | GM-7D | GM-8 | GM-9 | GM-10 | GM-11D | GM-11D DUPLICATE | GM-12 | GM-12 NAPL | GM-12 NAPL-2 | GM-13 | GM-14 | PW-1 | PW-3 | PW-5 | ON-SITE STORM SEWER | DELAWARE CREEK UPSTREAM | DELAWARE CREEK DOWNSTREAM | TRIP BLANK | FIELD BLANK | MUNICIPAL WATER SUPPLY | | | |
| DISSOLVED SOLIDS | mg/l | 458 | 415 | 1060 | 924 | 886 | 708 | 2130 | 606 | 570 | 436 | 532 | 412 | 396 | 408 | 728 | | | 662 | 590 | 406 | 448 | 598 | 428 | 224 | 82 | 16 | ND | 130 | | | |
| CHLORIDE | mg/l | 11.9 | 6.4 | 21.1 | 50.5 | 69.7 | 229 | 260 | 1 | 2.5 | 6.5 | < 1 | 1.5 | 1.5 | 1 | 25.5 | | N/A | 25.5 | 62.8 | 1 | 22.6 | 14.7 | 110 | 10.8 | 12.8 | < 1 | < 1 | 9.8 | | | |
| SULFATE | mg/l | 46.1 | 57.4 | 443 | 306 | 330 | 59 | 2.5 | 99 | 174 | 45.7 | 18.5 | 36.4 | 148 | 146 | 4.1 | | N/A | 49.2 | 113 | 130 | 82.1 | 230 | 50.8 | 20 | 20.4 | < 1 | 2.1 | 15.2 | | | |
| AMMONIA-NITROGEN | mg/l | 0.15 | 0.3 | 0.5 | 1130 | 1250 | 0.37 | 1.3 | 0.19 | 0.43 | 0.14 | 0.19 | 0.12 | 0.61 | 0.76 | < 0.1 | | N/A | 0.13 | 0.28 | 0.27 | < 0.10 | 0.57 | 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.17 | < 0.1 | | | |
| FORMALDEHYDE | mg/l | < 0.05 | 0.08 | 0.1 | 40.8 | 34.7 | < 0.4 | 0.24 | 0.1 | < 0.05 | 0.08 | 0.06 | 0.13 | < 0.05 | 0.06 | < 0.05 | | N/A | 0.12 | 0.18 | < 0.05 | < 0.05 | < 0.05 | < 0.02 | < 0.05 | < 0.05 | < 0.05 | 0.06 | < 0.05 | | | |
| PHENOLS, 4-AAP | mg/l | -- | -- | -- | -- | -- | -- | -- | -- | < 0.005 | -- | -- | -- | 0.014 | < 0.005 | -- | | N/A | -- | -- | 0.011 | < 0.005 | < 0.005 | -- | -- | -- | -- | -- | -- | | | |
| VOLATILE ORGANICS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACROLEIN | ug/l | < 10 | < 60 | < 4 | < 6 | < 4 | < 10 | < 3 | < 5 | < 7 | < 4 | < 20 | < 10 | < 6 | < 4 | < 0.03 | < 0.1 | < 4 | < 5 | < 30 | < 6 | < 2 | < 10 | | | < 4 | < 5 | < 6 | | | | |
| ACRYLONITRILE | ug/l | < 3 | < 10 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 4 | < 2 | < 1 | < 1 | < 0.005 | < 0.03 | < 1 | < 1 | < 7 | < 1 | < 1 | < 2 | | | < 1 | < 1 | < 1 | | | | |
| BENZENE | ug/l | < 0.6 | < 1 | < 0.1 | < 0.2 | < 0.1 | 3.4 | < 0.1 | < 0.1 | < 0.2 | < 0.1 | < 0.7 | < 0.2 | 1.4 | 1.2 | 0.032 | 0.08 | < 0.2 | < 0.2 | < 2 | < 0.2 | < 0.1 | < 0.5 | | | < 0.1 | < 0.2 | < 0.2 | | | | |
| BROMOFORM | ug/l | < 2 | < 4 | < 0.5 | < 0.7 | < 0.7 | < 3 | < 0.7 | < 0.4 | < 0.8 | < 0.7 | < 3 | < 2 | < 0.9 | < 0.5 | < 0.02 | < 0.2 | < 0.8 | < 0.9 | < 6 | < 0.7 | < 0.7 | < 3 | | | < 0.1 | < 0.2 | < 0.2 | | | | |
| CARBON TETRACHLORIDE | ug/l | < 1 | < 5 | < 0.3 | < 0.6 | < 0.3 | < 1 | < 0.3 | < 0.4 | < 0.6 | < 0.4 | < 2 | < 1 | < 0.6 | < 0.4 | < 0.002 | < 0.01 | < 0.4 | < 0.4 | < 3 | < 0.5 | < 0.3 | < 1 | | | < 0.5 | < 0.9 | < 0.7 | | | | |
| CHLOROBENZENE | ug/l | < 0.8 | < 1 | < 0.2 | < 0.2 | < 0.2 | < 0.9 | < 0.2 | < 0.1 | < 0.3 | < 0.2 | < 1 | < 0.6 | < 0.3 | < 0.2 | < 0.006 | < 0.06 | < 0.3 | < 0.3 | < 2 | < 0.2 | < 0.2 | < 1 | | | < 0.4 | < 0.4 | < 0.5 | | | | |
| CHLORODIBROMOMETHANE | ug/l | < 1 | < 3 | < 0.3 | < 0.4 | < 0.3 | < 2 | < 0.3 | < 0.3 | < 0.5 | < 0.3 | < 2 | < 0.5 | < 0.4 | < 0.3 | < 0.02 | < 0.05 | < 0.4 | < 0.6 | < 4 | < 0.4 | < 0.3 | 1 | | | < 0.3 | < 0.3 | < 0.2 | | | | |
| CHLOROETHANE | ug/l | < 1 | < 6 | < 0.4 | < 0.7 | < 0.4 | < 1 | < 0.4 | < 0.5 | < 0.8 | < 0.5 | < 2 | < 1 | < 0.7 | < 0.4 | < 0.003 | < 0.02 | < 0.4 | < 0.5 | < 4 | < 0.6 | < 0.4 | 1 | | | < 0.4 | < 0.5 | < 0.6 | | | | |
| 2-CHL'ETHYL V'L ETHER | ug/l | < 20 | < 80 | < 5 | < 0.9 | < 5 | < 20 | < 5 | < 7 | < 10 | < 6 | < 30 | < 20 | < 9 | < 6 | < 0.04 | < 0.2 | < 6 | < 7 | < 50 | < 8 | < 4 | < 20 | | | < 6 | < 7 | < 8 | | | | |
| CHLOROFORM | ug/l | < 0.8 | < 3 | 0.86 | < 0.4 | < 0.2 | < 0.6 | 1.3 | 2.6 | < 0.4 | < 0.2 | < 1 | < 0.6 | < 0.3 | < 0.2 | < 0.002 | < 0.008 | < 0.2 | < 0.3 | < 2 | < 0.3 | < 0.1 | < 0.6 | | | < 0.2 | 4.3 | 24 | | | | |
| DICHLOROBROMOMETHANE | ug/l | < 0.9 | < 2 | < 0.2 | < 0.3 | < 0.2 | < 1 | < 0.2 | < 0.2 | < 0.3 | < 0.2 | < 1 | < 0.3 | < 0.3 | < 0.2 | < 0.01 | < 0.04 | < 0.3 | < 0.4 | < 3 | < 0.3 | < 0.2 | < 0.8 | | | < 0.2 | 4.2 | 6.7 | | | | |
| 1,1-DICHLOROETHANE | ug/l | < 2 | < 8 | < 0.5 | < 0.9 | < 0.5 | < 2 | < 0.5 | < 0.7 | < 1 | < 0.6 | < 3 | < 2 | < 0.9 | < 0.6 | < 0.004 | < 0.02 | < 0.6 | < 0.7 | < 5 | < 0.8 | < 0.2 | < 2 | | | < 0.6 | < 0.7 | < 0.8 | | | | |
| 1,2-DICHLOROETHANE | ug/l | < 0.9 | < 4 | < 0.2 | < 0.4 | < 0.2 | < 0.7 | < 0.2 | < 0.3 | < 0.4 | < 0.3 | < 1 | < 0.7 | < 0.4 | < 0.3 | < 0.002 | < 0.009 | < 0.3 | < 0.3 | < 2 | < 0.4 | < 0.2 | < 0.9 | | | < 0.3 | < 0.3 | < 0.4 | | | | |
| 1,1-DICHLOROETHYLENE | ug/l | < 2 | < 7 | < 0.5 | < 0.8 | < 0.5 | < 1 | 5.2 | < 0.6 | < 0.9 | < 0.5 | < 3 | < 1 | < 0.8 | < 0.5 | < 0.003 | < 0.02 | < 0.5 | < 0.6 | < 5 | < 0.7 | < 0.2 | < 2 | | | < 0.5 | < 0.6 | < 0.7 | | | | |
| 1,2-DICHLOROPROPANE | ug/l | < 1 | < 3 | < 0.3 | < 0.4 | < 0.2 | < 1 | < 0.3 | < 0.3 | < 0.5 | < 0.3 | < 2 | < 0.4 | < 0.4 | < 0.3 | < 0.01 | < 0.05 | < 0.4 | < 0.5 | < 3 | < 0.4 | < 0.2 | < 1 | | | < 0.2 | < 0.4 | < 0.5 | | | | |
| CIS-1,3-DICHLOROPROPENE | ug/l | < 1 | < 2 | < 0.3 | < 0.3 | < 0.2 | < 1 | < 0.3 | < 0.2 | < 0.4 | < 0.3 | < 1 | < 0.4 | < 0.4 | < 0.2 | < 0.01 | < 0.05 | < 0.4 | < 0.5 | < 3 | < 0.4 | < 0.2 | < 1 | | | < 0.2 | < 0.4 | < 0.5 | | | | |
| TRANS-1,3-DICHL'PROPENE | ug/l | < 1 | < 2 | < 0.3 | < 0.4 | < 0.2 | < 1 | < 0.3 | < 0.2 | < 0.4 | < 0.3 | < 1 | < 0.4 | < 0.4 | < 0.2 | < 0.01 | < 0.05 | < 0.4 | < 0.5 | < 3 | < 0.3 | < 0.2 | < 1 | | | < 0.2 | < 0.4 | < 0.5 | | | | |
| ETHYL BENZENE | ug/l | < 2 | < 3 | < 0.4 | < 0.5 | < 0.5 | < 2 | < 0.5 | < 0.3 | < 0.5 | < 0.5 | < 2 | < 1 | < 0.6 | < 0.3 | < 0.01 | < 0.05 | < 0.4 | < 0.5 | < 3 | < 0.4 | < 0.2 | < 1 | | | < 0.2 | < 0.4 | < 0.5 | | | | |
| METHYL BROMIDE | ug/l | < 1 | < 5 | < 0.3 | < 0.6 | < 0.3 | < 1 | < 0.3 | < 0.4 | < 0.6 | < 0.4 | < 2 | < 1 | < 0.5 | < 0.4 | < 0.002 | < 0.01 | < 0.4 | < 0.4 | < 3 | < 0.5 | < 0.3 | < 1 | | | < 0.3 | < 0.6 | < 0.5 | | | | |
| METHYL CHLORIDE | ug/l | < 1 | < 6 | < 0.4 | < 0.7 | < 0.4 | < 1 | < 0.4 | < 0.5 | < 0.8 | < 0.5 | < 2 | < 1 | < 0.7 | < 0.5 | < 0.003 | < 0.02 | < 0.4 | < 0.5 | < 4 | < 0.6 | < 0.2 | < 1 | | | < 0.4 | < 0.4 | < 0.5 | | | | |
| METHYLENE CHLORIDE | ug/l | < 2 | 35 | 23 | < 0.8 | < 0.4 | < 1 | 9,700 | 17 | < 0.8 | < 0.5 | < 3 | < 1 | 13 | 19 | < 0.003 | 0.072 | < 0.5 | < 0.6 | 29 | < 0.7 | < 0.2 | 12 | | | < 0.4 | < 0.5 | < 0.6 | | | | |
| Sym-TETRACHL'ETHANE | ug/l | < 1 | < 2 | < 0.3 | < 0.4 | < 0.4 | < 2 | < 0.4 | < 0.3 | < 0.5 | < 0.4 | < 2 | < 1 | < 0.6 | < 0.3 | < 0.01 | < 0.1 | < 0.5 | < 0.5 | < 3 | < 0.4 | < 0.4 | < 2 | | | < 0.3 | < 0.6 | < 0.4 | | | | |
| TETRACHLOROETHYLENE | ug/l | < 2 | < 3 | < 0.4 | < 0.6 | < 0.6 | < 2 | < 0.6 | < 0.4 | < 0.7 | < 0.6 | < 3 | < 1 | < 0.8 | < 0.4 | < 0.01 | < 0.1 | < 0.7 | < 0.7 | < 5 | < 0.6 | < 0.6 | < 3 | | | < 0.4 | < 0.8 | < 0.6 | | | | |
| TOLUENE | ug/l | < 1 | < 2 | < 0.3 | < 0.3 | < 0.3 | < 1 | < 0.3 | < 0.2 | < 0.4 | < 0.3 | < 2 | < 0.8 | 2.8 | 3.4 | 0.043 | 0.5 | < 0.4 | < 0.4 | < 3 | < 0.4 | < 0.3 | < 2 | | | < 0.3 | < 0.6 | < 0.4 | | | | |
| 1,2,-t-DICHL'ETHYLENE | ug/l | < 2 | < 7 | < 0.4 | < 0.7 | < 0.4 | < 1 | 7 | < 0.6 | < 0.8 | < 0.5 | < 3 | < 1 | < 0.7 | < 0.5 | 0.085 | 0.23 | < 0.5 | < 0.5 | < 4 | < 0.7 | < 0.2 | < 1 | | | 1.6 | < 0.5 | < 0.3 | | | | |
| 1,1,1-TRICHL'ETHANE | ug/l | < 1.0 | < 4 | < 0.3 | < 0.4 | < 0.2 | < 0.8 | < 0.2 | < 0.3 | < 0.5 | < 0.3 | < 2 | < 0.8 | < 0.4 | < 0.3 | < 0.002 | < 0.01 | < 0.3 | < 0.3 | < 2 | < 0.4 | < 0.2 | < 0.9 | | | < 0.5 | < 0.6 | < 0.7 | | | | |
| 1,1,2-TRICHL'ETHANE | ug/l | < 2 | < 4 | < 0.4 | < 0.5 | < 0.3 | < 2 | < 0.4 | < 0.4 | < 0.7 | < 0.4 | < 2 | < 0.6 | < 0.6 | < 0.4 | < 0.02 | < 0.07 | < 0.6 | < 0.7 | < 5 | < 0.5 | < 0.4 | < 2 | | | < 0.3 | < 0.6 | < 0.8 | | | | |
| TRICHLOROETHYLENE | ug/l | < 2 | < 3 | < 0.4 | < 0.5 | < 0.3 | < 2 | < 0.4 | < 0.3 | < 0.6 | < 0.4 | < 2 | < 0.6 | < 0.5 | < 0.3 | < 0.02 | < 0.06 | < 0.5 | < 0.6 | < 4 | < 0.5 | < 0.3 | < 1 | | | < 0.3 | < | | | | | |

TABLE 6 (PAGE 2 OF 2)

RESULTS OF CHEMICAL ANALYSES - SECOND ROUND OF SAMPLING
OCTOBER/NOVEMBER 1986
PLASKON ELECTRONIC MATERIALS, INC.

| BASE-NEUTRALS | GM-12 (ug/L) | (GC/MS) GM-12 NAPL (mg/kg) | (GC) GM-12 NAPL-2 (mg/kg) | STORM SEWER (ug/L) |
|-----------------------------|-----------------|-------------------------------------|------------------------------------|--------------------------|
| ACENAPHTHENE | <1 | 11 | 13 | <1 |
| ACENAPHTHYLENE | <1 | <2 | <400 | <1 |
| ANTHRACENE | 530 | 46 | 176 | <1 |
| BENZIDINE | <2000 | <800 | | <30 |
| BENZO (a) ANTHRACENE | <1000 | <70 | <20000 | 7.3 |
| BENZO (a) PYRENE | <600 | 230 | <5000 | 12 |
| 3,4-BENZOFLUORANTHENE | <1000 | <100 | <20000 | 5.1 |
| BENZO (ghi) PERYLENE | <3000 | <300 | <45 | <3 |
| BENZO (k) FLUORANTHENE | <1000 | <100 | <15000 | 6.6 |
| bis(2-CHLOROETHOXY) METHANE | <1 | <3 | | <1 |
| bis(2-CHLOROETHYL)ETHER | <1 | <6 | | <1 |
| bis(2-CHLOROISOPROPYL)ETHER | <1 | <20 | | <3 |
| bis(2-ETHYLHEXYL)PHTHALATE | >750,000 | >82,000 | 40.1% | 1400 |
| 4-BROMOPHENYL PHENYL ETHER | <1 | <30 | | <1 |
| BUTYL BENZYL PHTHALATE | <2000 | 240 | 1680 | <3 |
| 2-CHLORONAPHTHALENE | <1 | <3 | | <1 |
| 4-CHLOROPHENYL PHENYL ETHER | <1 | <10 | | <1 |
| CHRYSENE | <900 | <60 | <5000 | 8.4 |
| DIBENZO(a,h)ANTHRACENE | <2000 | <200 | <25 | <3 |
| 1,2-DICHLOROBENZENE | <1 | <4 | | <1 |
| 1,3-DICHLOROBENZENE | <1 | <4 | | <1 |
| 1,4-DICHLOROBENZENE | <1 | <5 | | <1 |
| 3,3'-DICHLOROBENZIDINE | <2000 | <100 | | <3 |
| DIETHYL PHTHALATE | <1 | <20 | <1000 | <2 |
| DIMETHYL PHTHALATE | <1 | <4 | <1000 | <1 |
| DI-n-BUTYL PHTHALATE | <40 | 160 | <1000 | <1 |
| 2,4-DINITROTOLUENE | <5 | <30 | | <5 |
| 2,6-DINITROTOLUENE | <5 | <20 | | <5 |
| DI-n-OCTYL PHTHALATE | <1000 | <200 | 8.9% | 380 |
| 1,2-DIPHENYLHYDRAZINE | <1 | <5 | | <1 |
| FLUORANTHENE | 1200 | 100 | <67 | 16 |
| FLUORENE | <1 | 11 | 16 | <1 |
| HEXACHLOROBENZENE | <1 | <20 | | <1 |
| HEXACHLOROBUTADIENE | <1 | <9 | | <2 |
| HEXACHLOROCYCLOPENTADIENE | <1 | <30 | | <5 |
| HEXACHLOROETHANE | <1 | <10 | | <2 |
| INDENO (123-cd)PYRENE | <2000 | <200 | <90 | <3 |
| ISOPHORONE | <2 | <2 | | <2 |
| NAPHTHALENE | 200 | 15 | 10 | <1 |
| NITROBENZENE | <1 | <5 | | <1 |
| N-NITROSO-DIMETHYLAMINE | <1 | <7 | | <1 |
| N-NITROSO-DI-n-PROPYLAMINE | <2 | <50 | | <10 |
| N-NITROSO-DIPHENYLAMINE | <1 | <20 | | <1 |
| PHENANTHRENE | <1 | <8 | <51 | 3.9 |
| PYRENE | <50 | <20 | <42 | 12 |
| 1,2,4-TRICHLOROBENZENE | <1 | <7 | | <1 |

TABLE 7

REGIONAL HYDROSTRATIGRAPHY
PLASKON ELECTRONIC MATERIALS, INC.

| SYSTEM | SERIES | GROUP | FORMATION | AVERAGE THICKNESS | LITHOLOGY | WATER-YIELDING CHARACTERISTICS |
|----------|-------------|---------------|--|--------------------------|--|--|
| Cenozoic | Holocene | | | 0 - 180' | Quartzose sand | Sand and loamy, sand till; may yield small quantities of water to wells. |
| | Pleistocene | | | | Sand-rich glacial till grading into a clay-rich glacial till | |
| Devonian | Senecan | | Ohio | 100' | Soft to fissile, dark gray to brownish-black shale. | Non-water bearing |
| | Erian | Traverse | Ten Mile Creek | 40' | Soft, dark gray shaly limestone and dark brown shale with some greenish shale. | Non-water bearing. Very meager yields, less than 5 gpm. |
| | | | Silica | 40' | | |
| | | | Dundee | 65' | Light to medium buff limestone with medium to dark gray dolomite near the base. | Although entire thickness yields water, primary zones are 20' to 40' below top of formation. |
| | | Detroit River | Anderdon Lucas Amherstburg Sylvania | 35' 74' 15' 40' | Light to medium gray limestone grading to brown dolomite. | Most wells produce at 40' to 60' below base of Dundee |
| Silurian | Cayugan | Bass Islands | Raisin River Put-in-Bay | 50' 35' | Very hard, dense, medium to dark gray dolomite with some light gray dolomite. | Wells yield some water 20' to 50' above top of Tymochtee. Not as good an aquifer. |
| | | | Tymochtee | 150' | Medium grayish-brown dolomite with dark gray to black dolomite as distinctive horizon marker. | Typical wells yield 30' to 70' above Greenfield Formation. More than 73 percent of wells productive. |
| | | | Greenfield | 50' | Light gray to buff, hard dolomite with medium gray to buff dolomite. | Less than 31 percent of wells yields supplies. Typical zones are 20' to 30' above Lockport. |
| | Niagaran | | Lockport | 200' | Light gray to blue gray dolomite, often grayish-white to very white. Distinctive horizon marker. | Water obtained from entire thickness, 81 percent of wells yield water 50' to 80' below top of formation. |

TABLE 8

HYDRAULIC CONDUCTIVITY VALUES FOR GLACIAL SEDIMENTS
PLASKON ELECTRONIC MATERIALS, INC.

- 1) Values determined from in-situ hydraulic conductivity tests (bail tests) performed on monitoring wells at site.

HYDRAULIC CONDUCTIVITY

| WELL | Cm./Sec. | Ft./Day |
|----------------|-----------------------|---------|
| GM-1 | 1.22×10^{-5} | 0.035 |
| GM-2 | 3.24×10^{-6} | 0.009 |
| GM-3 | 3.77×10^{-5} | 0.107 |
| GM-4 | 4.99×10^{-5} | 0.141 |
| GM-5 | 6.28×10^{-6} | 0.018 |
| GM-7S | 3.40×10^{-5} | 0.096 |
| GM-9 | 1.20×10^{-5} | 0.034 |
| GM-10 | 6.90×10^{-5} | 0.196 |
| Geometric Mean | 1.8×10^{-5} | 0.05 |

- 2) Reported values from literature.

| A) Kunkle (1971) | Cm./Sec. | Ft./Day |
|--|----------------------|---------|
| - Based on areal recharge/ estimate: Vertical | 1.4×10^{-7} | 0.0004 |
| - Based on laboratory tests | 2.4×10^{-6} | 0.0068 |
| B) Starkey (1985) | | |
| - Based on laboratory tests: | | |
| Horizontal (4 samples) | 4.3×10^{-5} | 0.122 |
| Vertical (3 samples) | 8.6×10^{-7} | 0.002 |
| - Based on nine in-situ bail tests | 1.4×10^{-6} | 0.004 |

TABLE 9

VALUES OF TRANSMISSIVITY AND STORAGE COEFFICIENT
FOR DOLOMITE AQUIFER
PLASKON ELECTRONIC MATERIALS, INC.

Values were determined from analysis of data from pumping tests conducted on plant water wells by U.S. Geological Survey in 1947. See Appendix B for calculations.

| <u>WELL</u> | <u>TRANSMISSIVITY (GPD/FT)</u> | | <u>STORAGE COEFFICIENT</u> |
|-------------|--------------------------------|--------------------------|----------------------------|
| | <u>Drawdown Data</u> | <u>Recovery Data</u> | |
| PW-1 | 7200 | 9600 | 3.2×10^{-4} |
| PW-2* | 7200 | 6600 | |
| PW-3 | 7600 | 8800 | 3.1×10^{-5} |
| PW-4 | 8000 | 8900 | 1.4×10^{-4} |
| PW-5* | <u>8500</u> | <u>7400</u> | |
| Average | 7700 | 8300 | |

* Pumping Wells

GPD/FT - Gallons per day per foot.

105plaskon/transmis.tbl

TABLE 10

ORGANIC COMPOUNDS DETECTED IN FIELD BLANKS, TRIP BLANKS
AND MUNICIPAL SUPPLY
PLASKON ELECTRONIC MATERIALS, INC.

| | First Round | | | Second Round | | |
|---------------------------------|---------------|----------------|---------------------|---------------|----------------|---------------------|
| | Trip Blank | Field Blank | Municipal Supply | Trip Blank | Field Blank | Municipal Supply |
| Chloroform | 21 | 0.64 | 52 | - | 43 | 24 |
| Dichlorobromomethane | 5 | - | 9.2 | - | 4.2 | 6.7 |
| Chlorodibromomethane | - | - | 2.3 | - | 1.7 | 6 |
| Methylene Chloride | 7.7 | - | - | 24 | - | 20 |
| Toluene | 2.1 | - | - | 1.6 | - | - |
| 1,4 Dichlorobenzene | 1.1 | - | - | - | - | - |
| Napthalene | 3.0 | - | - | - | NA | NA |
| Bis (2-ethylhexyl) Phthalate | 29 | - | - | - | - | - |

* - All values in micrograms/liter (ug/l)

NA - Not analyzed

105plaskson/blkdet.wk1

TABLE 11

SUMMARY OF CHEMICAL ANALYSES FOR WELLS
PLASKON ELECTRONIC MATERIALS, INC.

| | First Round Sampling | | Second Round Sampling | | Water Quality Criteria | | | | | |
|------------------------------|----------------------|----------------|-----------------------|----------------|--|---------------------------------|------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | Wells | Maximum (ug/l) | Wells | Maximum (ug/l) | SDWA (1) Maximum Contaminant Level (ug/l) | Lifetime Health Advisory (ug/l) | CWA (2) Ambient Criteria (ug/l) | -4 10 Excess Cancer Risk (ug/l) | -6 10 Excess Cancer Risk (ug/l) | -7 10 Excess Cancer Risk (ug/l) |
| Volatile Organics | | | | | | | | | | |
| Benzene | - | - | *5, 11D, PW-1 | 3.4 (8) | 5 | - | - | - | 0.35 (6) | 0.035 |
| Chloroform | 6 | 3.3 | 3,6,*7S | 2.6 | 100 (4) | - | - | - | 0.19 (7) | 0.019 |
| Ethylbenzene | 4 | det | - | - | 680 (5) | 680 | 1400 | 35 | - | - |
| 1,1 Dichloroethylene | - | - | 6 | 5.2 | 7 | 70 | - | - | 0.24 (6) | 0.024 |
| Methylene Chloride | *6,3 | 3200 | *6,2,3,7S,11D,PW-1 | 9700 | - | 350 | - | - | 5 (6) | 0.05 |
| Toluene | - | - | 11D,*11D-dup | 3.4 (8) | 2000 (5) | 2000 | 14,300 | 19 | - | - |
| 1,2-Trans-dichloroethylene | 6 | 5.2 | 6 | 7.0 (8) | 70 (5) | 70 | - | - | - | - |
| Vinyl Chloride | 6-dup | 2.3 | 6 | 4.5 (8) | 2 | - | - | - | 0.015 (6) | 0.0015 |
| Phenols | | | | | | | | | | |
| Phenol | *7D,11D,PW-5 | 35 | NA | NA | - | - | 3,500 | 24 | - | - |
| Phthalate Esters | | | | | | | | | | |
| Bis (2-ethylhexyl) Phthalate | *GM-12 | 3700 | 4-dup | 7 (8) | - | - | 15,000 | 500 | - | - |
| | ALL except 6,9 | | | | | | | | | |
| Butyl Benzyl Phthalate | 11D-dup | det | - | - | - | - | - | - | - | - |
| Diethyl Phthalate | 7D,11D | det | - | - | - | - | 350,000 | 1.5 | - | - |
| Di-n-butyl Phthalate | 1,2,3,4,5,*7D,11D,13 | 4.9 | - | - | - | - | 34,000 | 0.28 | - | - |
| Di-n-octyl Phthalate | 12 | 5.7 | - | - | - | - | - | - | - | - |
| Polynuclear Aromatics | | | | | | | | | | |
| Anthracene | 7D | 2.5 | (9) | (8) | - | - | - | - | 0.0028 (7) | 0.00028 |

(1) SDWA Safe Drinking Water Act - Primary Drinking Water Standards

(2) CWA Clean Water Act - Water quality criteria for protection of human health

(3) PROPOSED Maximum Contaminant Level (MCL)

(4) Maximum contaminant level is 100 ug/l for total trihalomethanes, which includes chloroform, bromoform, bromodichloromethane, and dibromochloromethane

(5) PROPOSED Maximum Contaminant Level Goal (MCLG). Formerly known as Recommended Maximum Contaminant Level (RMCL).

(6) Most recent 10-6 excess cancer risk level determined by U.S. Environmental Protection Agency, Carcinogen Assessment Group (CAG)

(7) 10-6 excess cancer risk level

(8) These compounds were also detected in sample from well GM-12, which contained globules of nonaqueous phase liquid. See Table 6 for detected concentrations.

(9) Only analyzed for in samples from GM-12, the storm sewer, and sample of non-aqueous phase liquid from well GM-12. See Table 6.

(10) Lifetime Health Advisory - non-mandatory guidance for drinking water suppliers provided by the Office of Drinking Water (EPA).

NA - Not analyzed

det- Detected, quantification less than detection limit

* - Well in which maximum concentration occurred

TABLE 12

SUMMARY OF SOIL-BORING INFORMATION NEAR THE PLASTICIZER
TANK FARM AND METHYLENE CHLORIDE TANK

| BOREHOLE | DATE DRILLED | TOTAL DEPTH (FEET) | DEPTH TO WATER (FEET) | PRESENCE OF NAPL IN BOREHOLE (VISUAL OBSERVATION) | | | SOIL ANALYSES | |
|----------|-----------------|--------------------------|-----------------------------|--|-------|---------|-----------------|--------------------------|
| | | | | 02/10 | 02/11 | 02/12 | DEPTH (FEET) | ANALYSES(2) PERFORMED |
| TB-12A | 02/09/87 | 18 | 2.3 | YES | YES | YES | 5-7 | B/N, VOCs |
| TB-12B | 02/09/87 | 15 | 4.2 | YES | YES | YES | | |
| TB-12C | 02/09/87 | 12 | 3.8 | NO | NO | NO | | |
| TB-12D | 02/10/87 | 13 | 4.3 | YES | YES | YES | | |
| TB-12E | 02/10/87 | 13 | 1.2 | SLIGHT | YES | YES | | |
| TB-12F | 02/10/87 | 12 | 2.6 | YES | YES | YES | 10-12 | B/N |
| TB-12G | 02/10/87 | 13 | 4.5 | NO | YES | YES | | |
| TB-12H | 02/10/87 | 13 | 2.2 | YES | YES | YES | 8-10 | B/N |
| TB-12I | 02/10/87 | 13 | 3.1 | - | NO | YES | 5-7 | B/N |
| TB-12J | 02/11/87 | 13 | 3.0 | - | NO | NO | | |
| TB-12K | 02/11/87 | 13 | 5.5 | - | NO | NO | | |
| TB-12L | 02/11/87 | 13 | 1.2 | - | NO | NO | | |
| TB-12M | 02/11/87 | 10 | - | - | YES | YES | 5-7 | B/N, VOCs |
| TB-12N | 02/13/87 | 11 | - | - | - | YES (1) | | |
| TB-6A | 02/11/87 | 19 | 2.4 | | | | | |
| TB-6B | 02/11/87 | 17 | 2.3 | | | | 5-7; 6-10 | MC |
| TB-6C | 02/11/87 | 18 | 0.6 | | | | 6-8; 16-18 | MC |
| TB-6D | 02/12/87 | 24 | 2.7 | | | | 7-9; 17-19 | MC |
| TB-6E | 02/12/87 | 19 | 2.6 | | | | 7-9; 17-19 | MC |

(1) Observation made on 2/13/87.

(2) B/N - Base-neutral extractable compounds

VOCs - Volatile organic compounds

MC - Methylene Chloride

TABLE 13

SUMMARY OF ANALYTICAL
RESULTS OF SOIL-BORING
SAMPLES NEAR THE PLASTICIZER TANK FARM

| Borehole I.D. and Respective Sample Depths (All Values are in milligrams/kilogram) | | | | | |
|---|-------------------|---------------------|--------------------|-------------------|-------------------|
| | TB-12A (5'-7') | TB-12F (10'-12') | TB-12H (8'-10') | TB-12I (5'-7') | TB-12M (5'-7') |
| PHTHALATES | | | | | |
| BIS (2-ETHYLHEXYL) PHTHALATE | 190 | 0.73 | 3.3 | 53 | 450 |
| DI-n-OCTYL PHTHALATE | 2.5 | <0.03 | 0.41 | 15 | <0.5 |
| DI-n-BUTYL PHTHALATE | <0.01 | <0.02 | <0.01 | <0.01 | (D)<0.02 |
| POLYNUCLEAR AROMATICS | | | | | |
| BENZO(a)ANTHRACENE | <0.01 | <0.02 | 0.041 | <0.01 | <0.03 |
| BENZO(a)PYRENE | <0.07 | <0.02 | 0.048 | <0.01 | <0.03 |
| BENZO(k)FLUORANTHENE | <0.1 | <0.02 | 0.094 | <0.01 | <0.02 |
| CHRYSENE | <0.009 | <0.02 | 0.051 | <0.010 | <0.02 |
| FLUORANTHENE | <0.010 | <0.02 | 0.1 | <0.01 | <0.02 |
| FLUORENE | <0.01 | <0.02 | (D)<0.02 | <0.01 | <0.02 |
| NAPHTHALENE | <0.008 | <0.01 | 0.043 | <0.008 | (D)<0.02 |
| PHENANTHRENE | <0.008 | <0.01 | 0.15 | <0.009 | <0.02 |
| PYRENE | <0.008 | <0.01 | 0.052 | <0.009 | <0.02 |
| VOLATILES | | | | | |
| BENZENE | <0.001 | NA | NA | NA | 0.0002 |
| CHLOROFORM | <0.004 | NA | NA | NA | 0.0012 |
| 1-2 DICHLOROPROPANE | <0.003 | NA | NA | NA | (D)<0.0004 |
| METHYLENE CHLORIDE | <0.009 | NA | NA | NA | 0.1 |
| 1-1-1 TRICHLOROETHANE | <0.007 | NA | NA | NA | (D)<0.0004 |
| TRICHLOROETHYLENE | <0.003 | NA | NA | NA | (D)<0.0004 |

A value preceded by a less than sign (i.e. <0.01) is the detection limit reported by laboratory. The reported detection limit is established by the laboratory to be equal to the baseline signal plus three times the noise level. A specific concentration is reported for any signal equal to or greater than the detection limit. For signals between one time and three times the noise level, the compound is reported to be detected (D), but its concentration is not quantified.

NA - Not analyzed.

TABLE 14

SUMMARY OF ANALYTICAL RESULTS OF SOIL-BORING SAMPLES
NEAR THE METHYLENE CHLORIDE TANK

| BOREHOLE ----- | DEPTH (FEET) ----- | METHYLENE CHLORIDE CONCENTRATION (MG/KG) ----- |
|-------------------|--------------------------|---|
| TB-6B | 5-7 | <0.13 |
| TB-6B | 10-12 | <0.25 |
| TB-6C | 6-8 | <0.25 |
| TB-6C | 16-18 | <0.25 |
| TB-6D | 7-9 | 0.15 |
| TB-6D | 17-19 | <0.25 |
| TB-6E | 7-9 | <0.13 |
| TB-6E | 17-19 | <0.13 |

105plaskon/methylen.wk1

TABLE 15

PHYSICAL PROPERTIES OF ORGANIC CHEMICAL CONSTITUENTS DETECTED IN
WELL AND STORM SEWER SAMPLES

| | Density | Aqueous Solubility | Log Henry's Constant | Log Kow | Kd | Molecular Weight |
|---------------------------------------|---------|-----------------------|-------------------------|---------|-----------|---------------------|
| Volatiles ----- | | | | | | |
| Benzene | 0.879 | 1780 | -2.26 | 2.31 | 1.26 | 78.11 |
| Ethylbenzene | 0.867 | 206 | -2.19 | 3.15 | 8.71 | 106.17 |
| Toluene | 0.867 | 535 | -2.23 | 2.69 | 3.02 | 92.13 |
| Bromoform | 2.89 | 3010 | -3.27 | 2.30 | 1.23 | |
| Chloroform | 1.489 | 8000 | -2.47 | 1.97 | 0.58 | |
| 1,1-Dichloroethylene | 1.218 | 5000 | -1.82 | 1.48 | 0.19 | |
| Methylene Chloride | 1.326 | 16,700 | -2.5 | 1.25 | 0.11 | |
| 1,2-Trans-Dichloroethylene | 1.27 | 6300 | -2.27 | 1.48 | 0.19 | |
| Vinyl Chloride | 0.912 | 1.1 | -1.44 | 0.60 | 0.03 | |
| Phenols ----- | | | | | | |
| Phenol | 1.071 | 67,000 | -5.89 | 1.46 | 0.18 | |
| Phthalate Esters ----- | | | | | | |
| Bis (2-ethylhexyl) Phthalate | 0.985 | 0.4 | -- | 8.73 | 3,311,000 | |
| Butyl Benzyl Phthalate | | 2.9 | -- | 4.78 | 371 | |
| Diethyl Phthalate | | 1000 | -6.07 | 3.22 | 10.2 | |
| Di-n-butyl Phthalate | 1.047 | 400 | -- | -- | -- | |
| Di-n-octyl Phthalate | 0.978 | 3 | -- | 9.2 | 9,800,000 | |
| Polynuclear Aromatics ----- | | | | | | |
| Anthracene | 1.25 | 0.073 | -4.64 | 4.45 | 174 | |
| Acenaphthene | | 3.42 | -3.63 | 4.33 | 132 | |
| Benzo (a) Anthracene | | 0.014 | -- | 5.61 | 2,510 | |
| Benzo (a) Pyrene | 1.351 | 0.0038 | -1.9 | 6.04 | 6,760 | |
| 3,4 Benzo (k) Fluoranthene | | NA | -- | 6.57 | 22,900 | |
| Benzo (k) Fluoranthene | | 0.00025 | -2.98 | 6.84 | 42,700 | |
| Chrysene | 1.274 | 0.006 | -- | -- | -- | |
| Fluoranthene | 1.252 | 0.26 | -- | 5.33 | 1,320 | |
| Fluorene | 1.203 | | -3.93 | | | |
| Napthalene | | 34.4 | -3.44 | 3.37 | 14.5 | |
| Phenanthrene | 1.179 | 1.29 | -3.97 | 4.46 | 178 | |
| Pyrene | 1.271 | 0.14 | -- | 5.32 | 1,290 | |
| Other Organics ----- | | | | | | |
| Formaldehyde | 0.815 | | | | | |

Density - gm/cm³ at 20 degrees C

Aqueous Solubility - mg/l at 25 degrees C

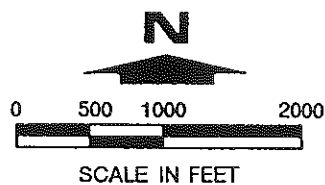
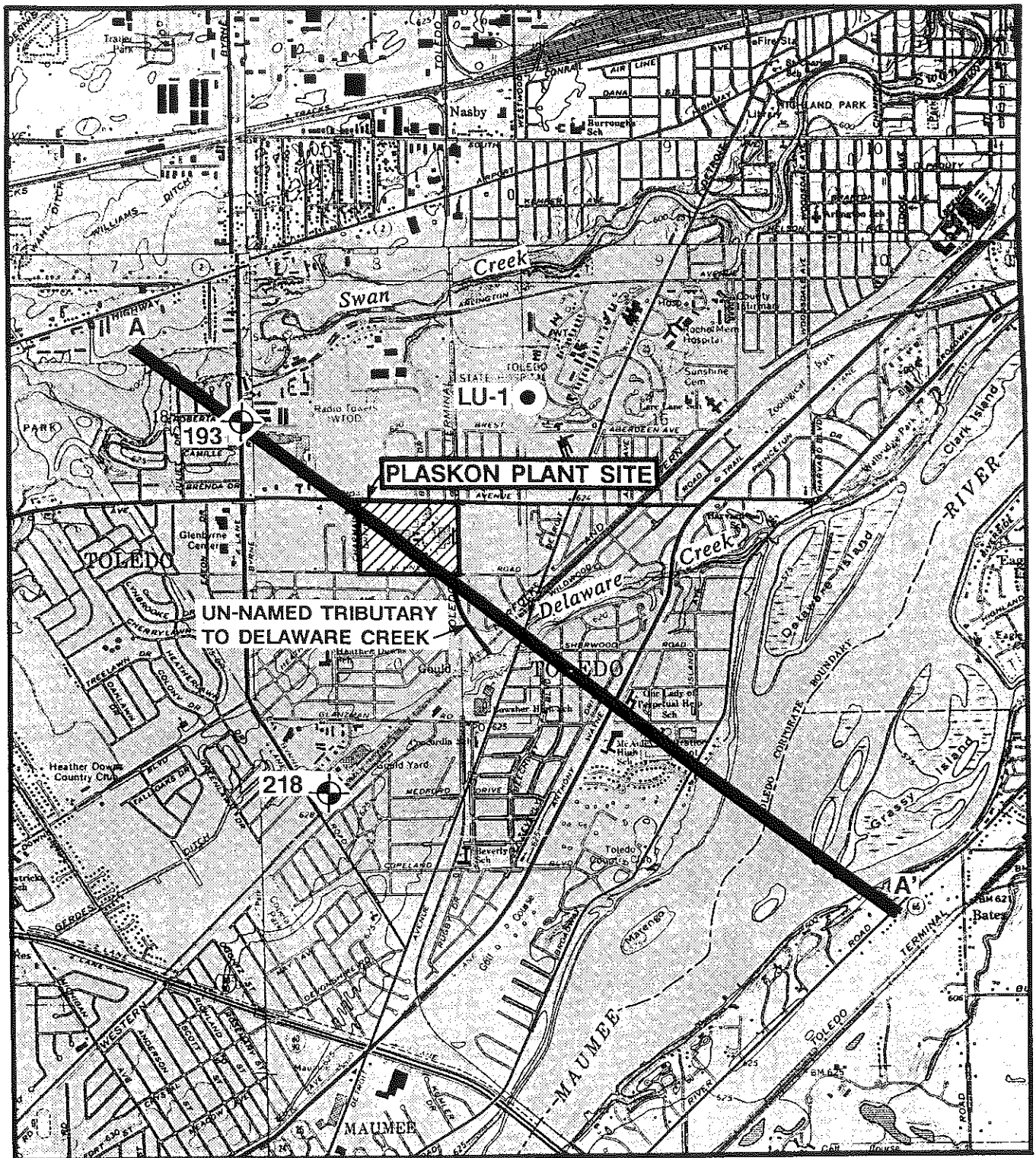
Log of Henry's Constant - atm.m³/mole at 25 degrees C

Log Kow - Log Octanol/Water Partition Coefficient

Kd - Distribution Coefficient - assuming 1% organic carbon

Sources: Verschuieren, 1983; Saar & Spriezer, 1985; U.S. Coast Guard, 1984

FIGURES



LEGEND

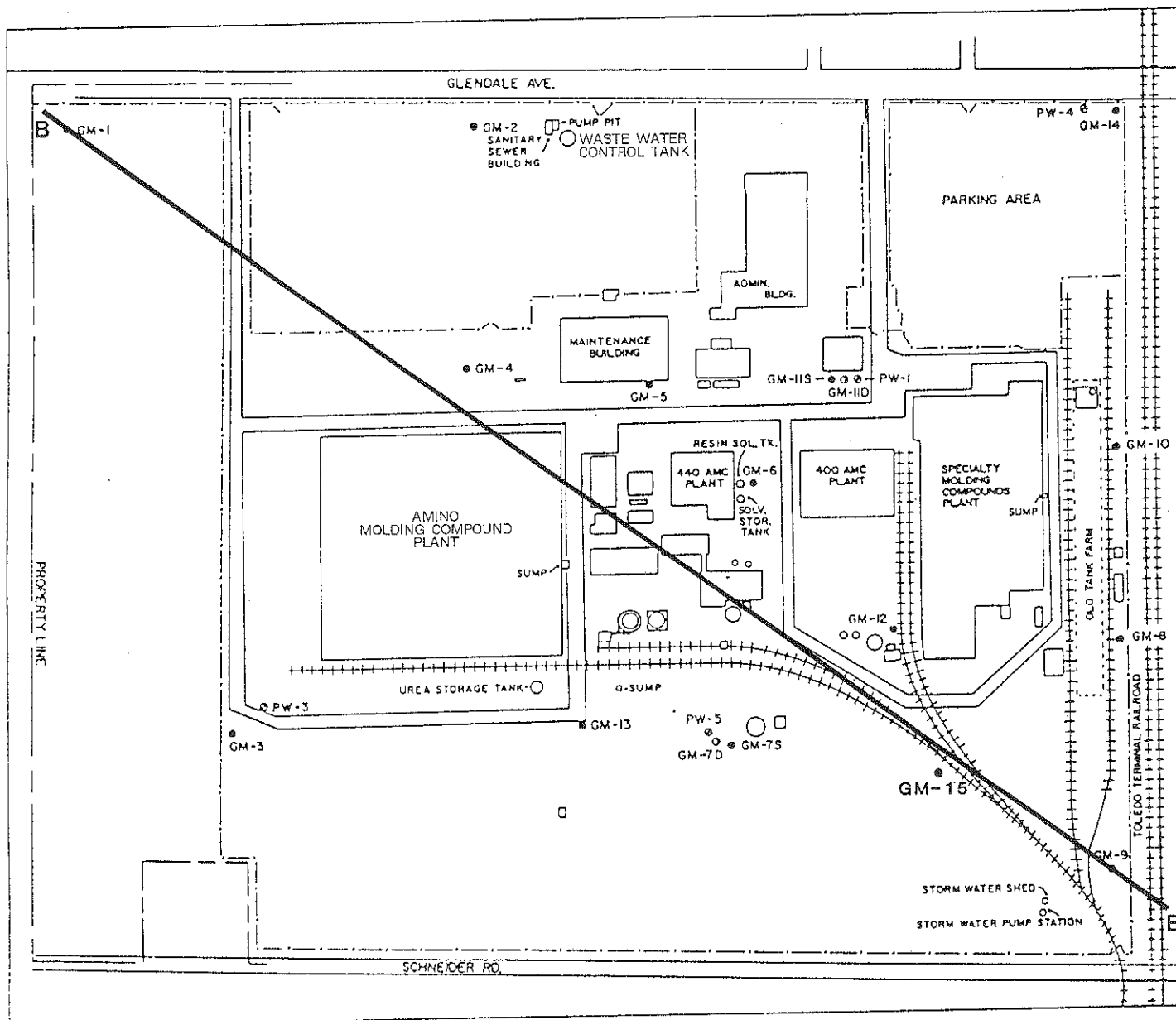
A-A' GEOLOGIC CROSS SECTION A-A' SHOWN IN FIGURE 9

● U.S. GEOLOGICAL SURVEY
LU-1 OBSERVATION WELL

⊙ LOCATION AND I.D. NO.
OF WELL WITH DATA IN
193 FILES OF OHIO DNR

← RIVER FLOW DIRECTION





0 100 200 300
SCALE IN FEET

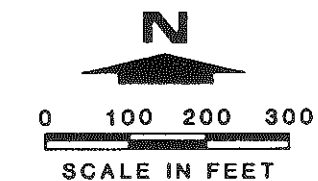
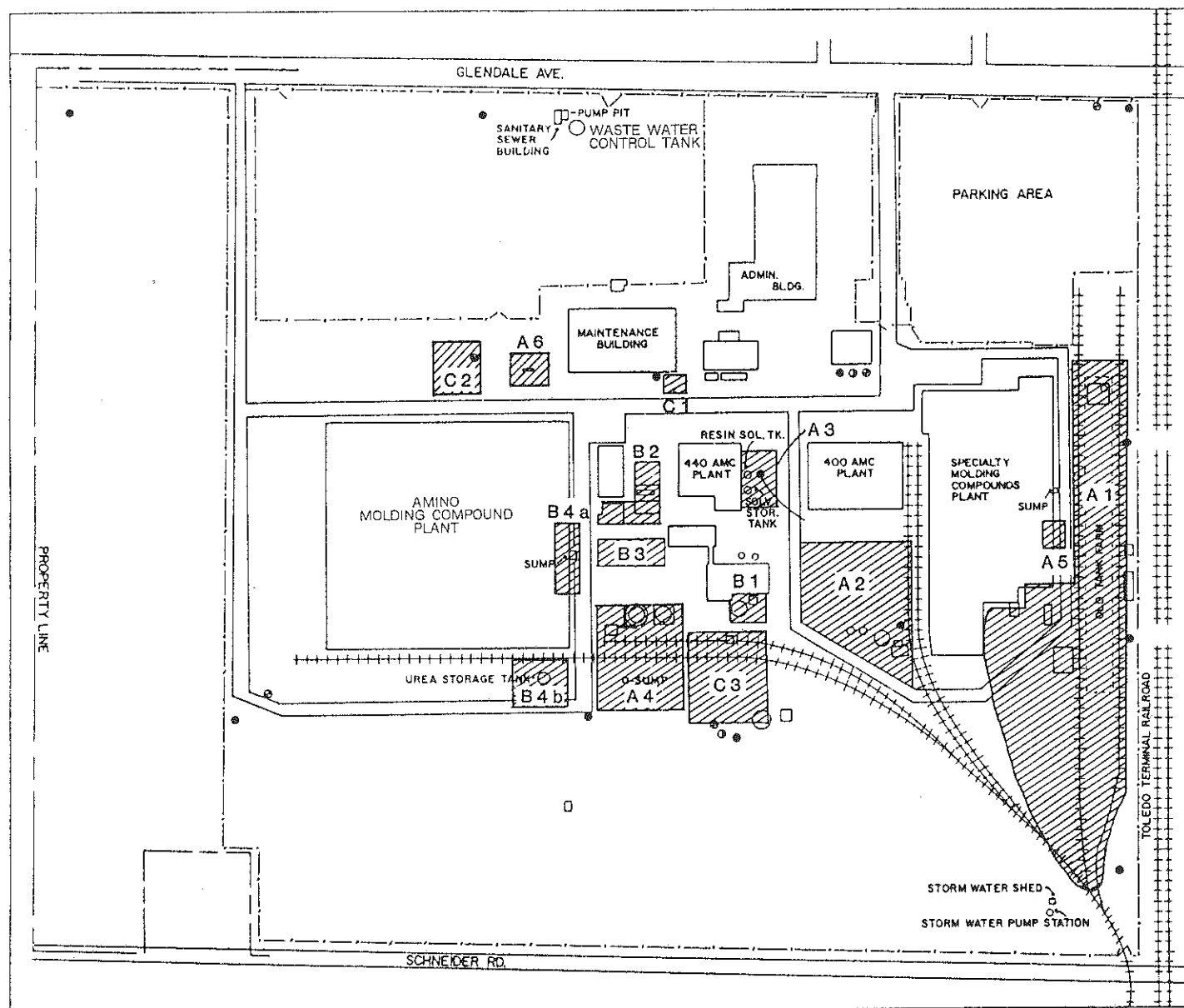
LEGEND

- 2" PVC WELL
- 4" PVC WELL
- ⊗ PLANT WELL (INACTIVE)

B-B' GEOLOGIC CROSS SECTION SHOWN IN FIGURE 10

NOTE:
GM-11S FOR LOCATION ONLY - ABANDONED 4-2-86

FIGURE 2
SITE MAP AND
MONITORING WELL LOCATIONS



LEGEND

- 2" PVC WELL
- 4" PVC WELL
- ⊙ PLANT WELL (INACTIVE)

A. MAJOR LIQUID STORAGE AREAS

- A1 EAST TANK FARM
- A2 PLASTICIZER TANK FARM
- A3 POLYESTER RESIN TANKS
- A4 FORMALDEHYDE/FUEL OIL TANKS
- A5 DOWTHERM OIL TANK
- A6 DIESEL TANK
- * A7 UNDERGROUND GASOLINE TANK

B. OTHER CHEMICAL STORAGE AND USE AREAS

- B1 BOILER WATER TREATMENT CHEMICALS
- B2 WATER TREATMENT CHEMICALS
- B3 CHLOROSILANE HYDROLYSIS
- B4a UREA STORAGE
- B4b UREA STORAGE

C. OTHER AREAS

- C1 WASTE OIL SUMP
- C2 WET-DUST COLLECTION SETTLING POND
- C3 COAL STORAGE PILE

See attachment
on following page
for lists of stored chemicals
in respective areas.

FIGURE 3 ATTACHMENT
HISTORIC AREAS OF CHEMICAL STORAGE AND USE
PLASKON ELECTRONIC MATERIALS, INC.

A. MAJOR LIQUID STORAGE AREAS

A1 - East Tank Farm

Castor Oil
 Linseed Oil
 Soya Oil
 Coconut Oil
 Naphtha
 Mineral Spirits (Varnolene
 Solvesso-150
 Diallyl Phthalate
 Styrene
 Vinyl Toluene
 Cresol
 Phenol
 Tar Acids
 Phenolic Resin (water
 soluble)
 Linseed Oil Distillate
 Phthalic Anhydride
 2-Ethyl hexanol
 Isodecyl Alcohol
 Isobutanol
 Butanol
 Diethylene Glycol
 Propylene Glycol
 Ethylene Glycol
 Glycerine
 Ethanol
 Formaldehyde Solution
 Ammonium Hydroxide
 Hydrochloric Acid
 Sodium Hydroxide
 Fuel Oil
 Methylene Chloride

A2 - Plasticizer Tank Farm

Alcohol Mixture: 6, 8, 10,
 Carbon (Alfol-6, 10)
 Isooctyl Alcohol
 Maleic Anhydride
 Dioctyl Phthalate
 Di-(isooctyl phthalate)
 Di-(isodecyl phthalate)
 Di-(Alfol-6.10) phthalate

A3 - Polyester Resin Tanks

Polyester Resin (from Maleic
 Anhydride, Tetrachloro-
 phthalic Anhydride, Propy-
 lene Glycol, Ethylene Glycol
 Methylene Chloride

**A4 - Formaldehyde and Fuel
 Oil Tanks**

Formaldehyde
 Fuel Oil
 Cresol

A5 - Dowtherm Oil Tank

Dowtherm Oil

**A6 - Diesel Tank/Underground
 Gasoline Tank**

Gasoline
 Diesel Fuel

**B. OTHER CHEMICAL STORAGE
 AND USE**

**B1 - Boiler Water Treatment
 Chemicals**

Chromate Salts, Amines

B2 - Water Treatment Chemicals

Sulfuric Acid
 Biocides
 Chlorine

B3 - Chlorosilane Hydrolysis

Hydrochloric Acid

B4 - Urea Storage

Urea
 Melamine

**C. OTHER MISCELLANEOUS AREAS
 OF INTEREST**

C1 - Waste Oil Sump

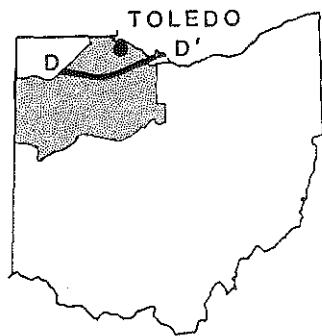
Waste Oil

C2 - Wet Dust Collection

Urea Formaldehyde and Melamine
 Formaldehyde Molding Compound
 Cellulose
 Hexamethylene Tetramine
 Zinc Sulfate
 Zinc Stearate
 Tetrachlorophthalic Acids
 Pigments

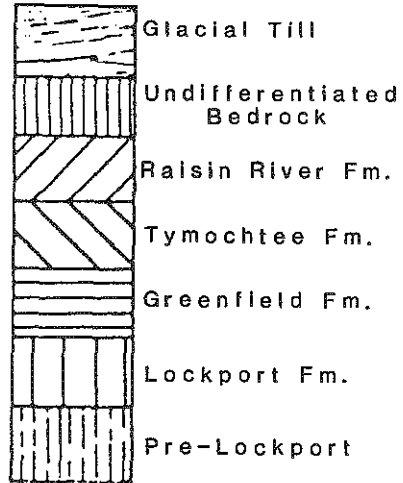
C3 - Coal Storage Pile

Residues from coal



LOCATION OF
CROSS SECTION AREA

LEGEND



(SEE TABLE 7 FOR
DESCRIPTION OF FORMATIONS)

(FROM OHIO DNR, 1970)

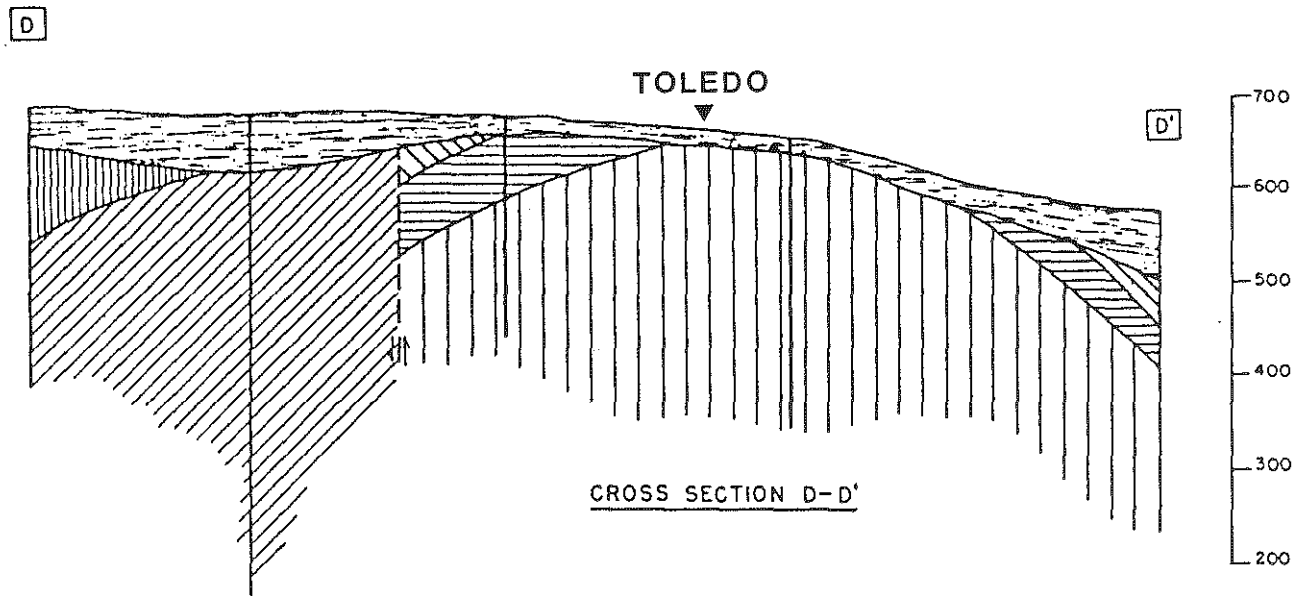
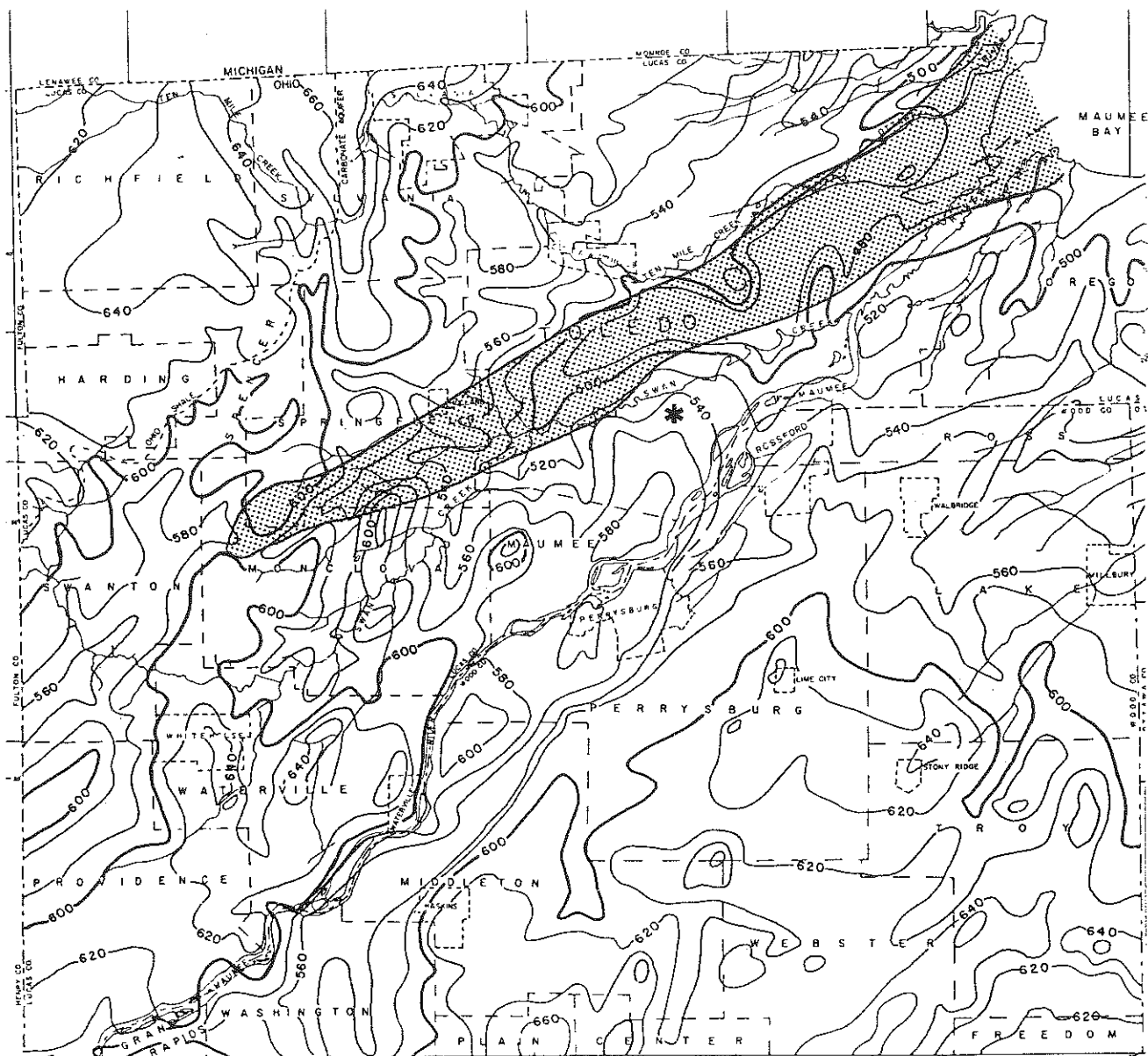

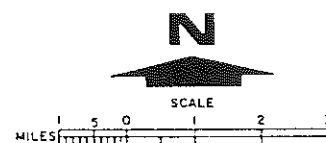


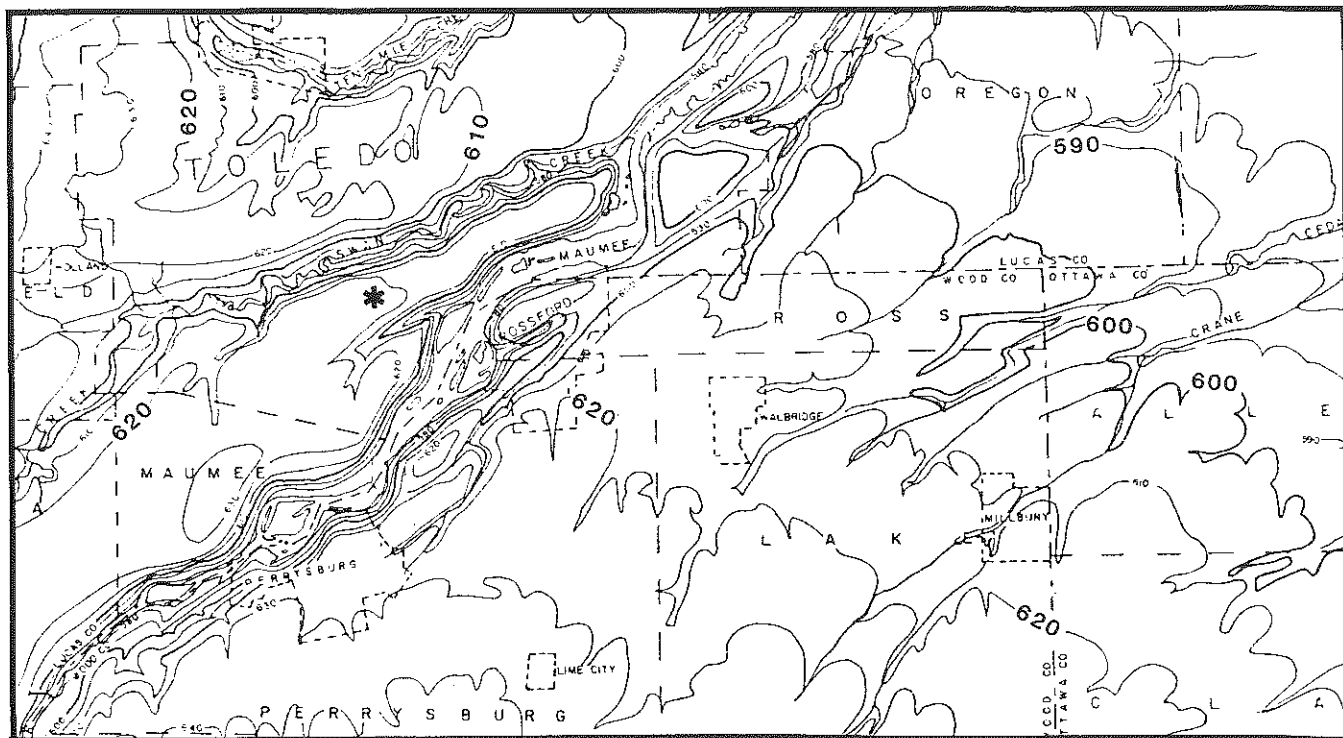
FIGURE 4
REGIONAL GEOLOGIC CROSS SECTION
NORTHWEST OHIO



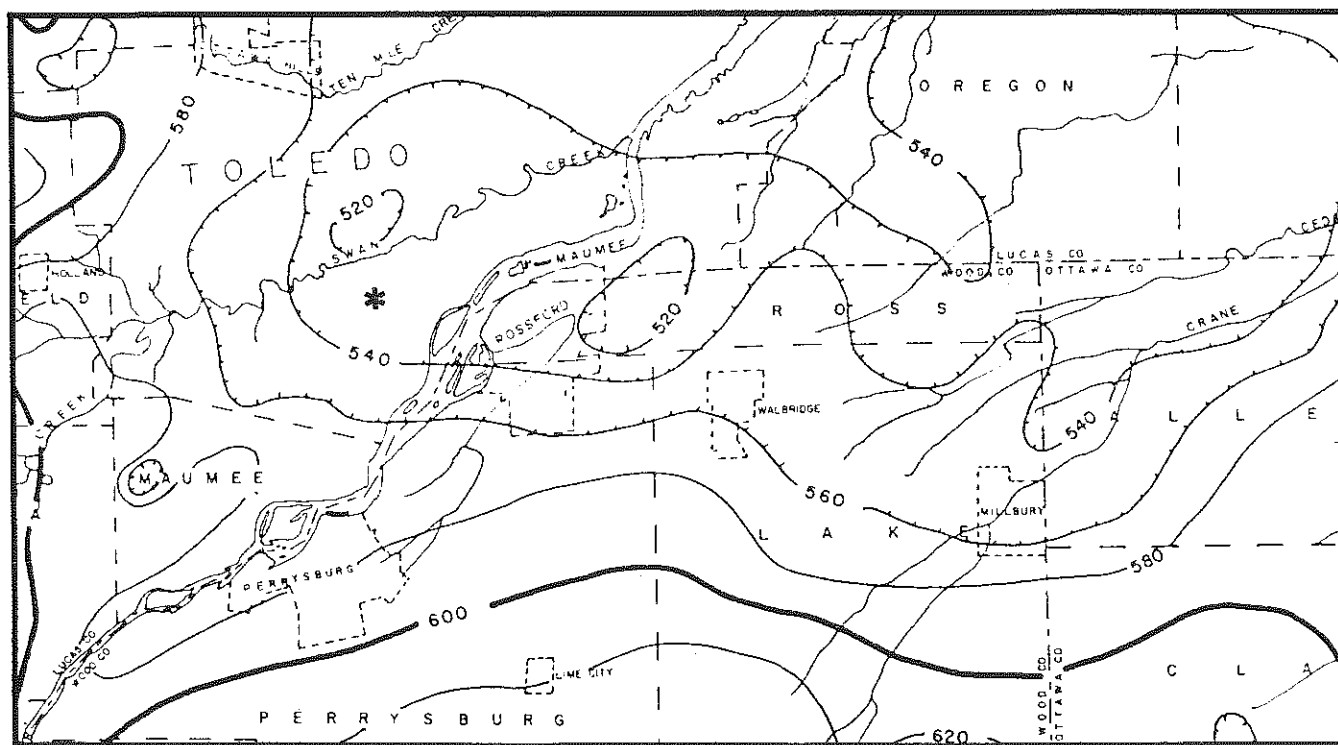
LEGEND

- * PLASKON PLANT SITE
- 600 —
CONTOUR OF THE BEDROCK SURFACE
DATUM IS MEAN SEA LEVEL
CONTOUR IS 20 FEET
-  LOCATION OF SAND AND GRAVEL
FILLED BEDROCK VALLEY
(LOCATION OF VALLEY FROM
HALLFRISCH, 1986)





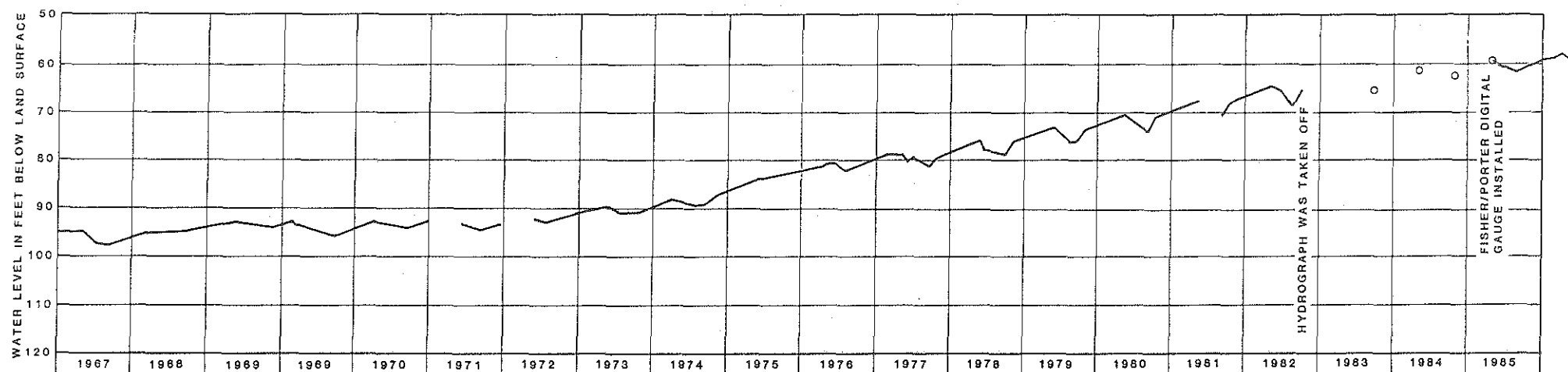
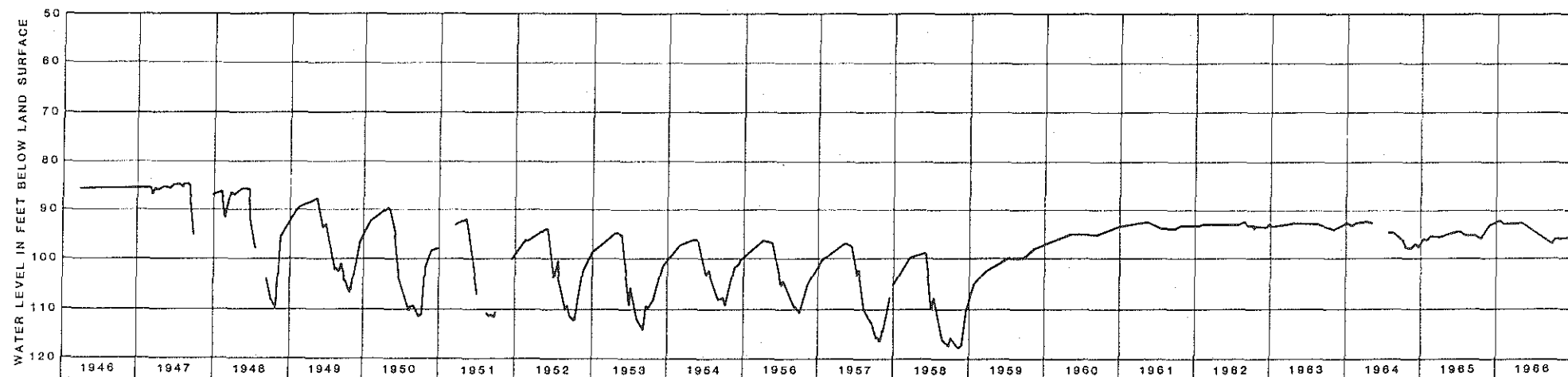
WATER TABLE



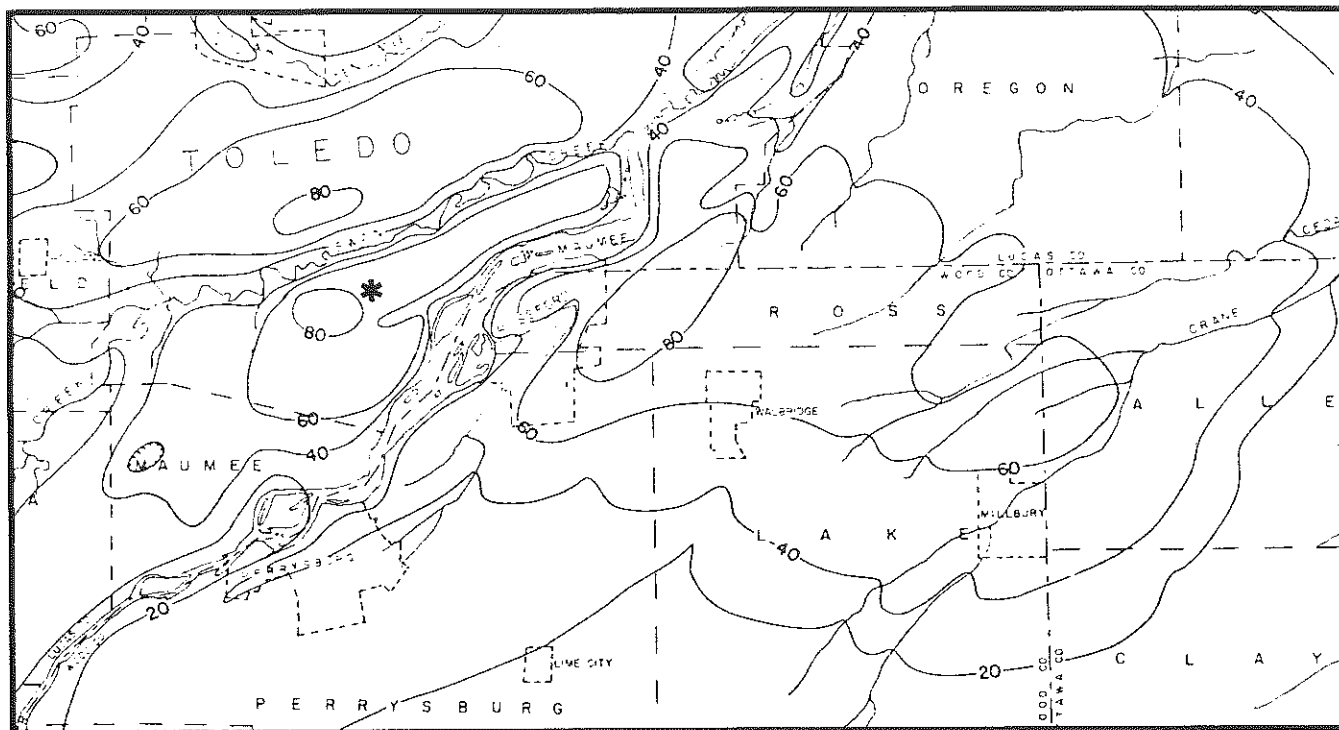
POTENTIOMETRIC SURFACE OF DOLOMITE

LEGEND

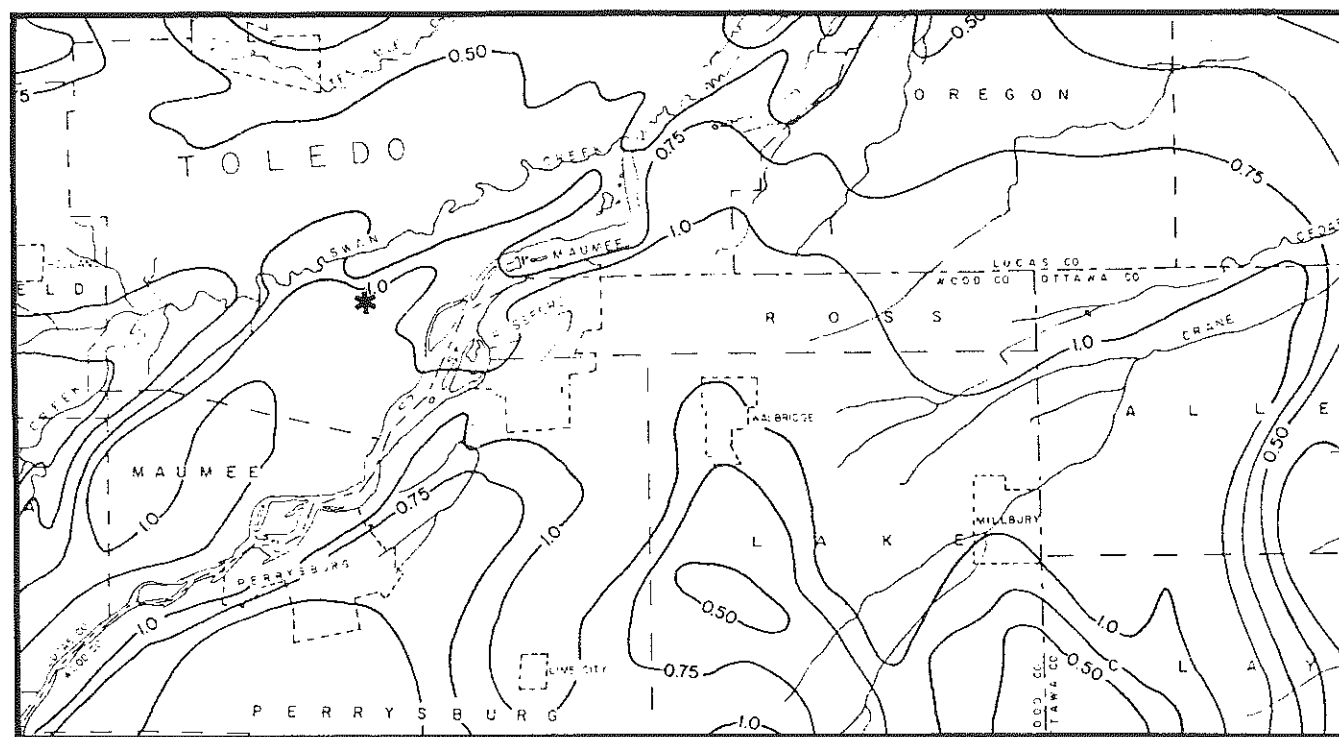
- * PLASKON PLANT SITE
- 580— WATER TABLE OR
POTENTIOMETRIC SURFACE
(FEET ABOVE SEA LEVEL)



NOTE: WELL LOCATION SHOWN ON FIGURE 1



VERTICAL HEAD LOSS



VERTICAL HYDRAULIC GRADIENT

LEGEND

- * PLASKON PLANT SITE
- 0.75— VERTICAL HYDRAULIC GRADIENT
CONTOUR INTERVAL IS 0.25 FOOT/FOOT
- 20 VERTICAL HEAD LOSS
CONTOUR INTERVAL IS 20 FEET

**GERAGHTY
& MILLER, INC.**
Ground-Water Consultants

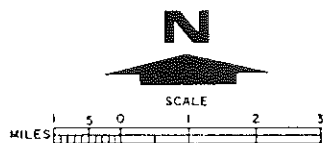
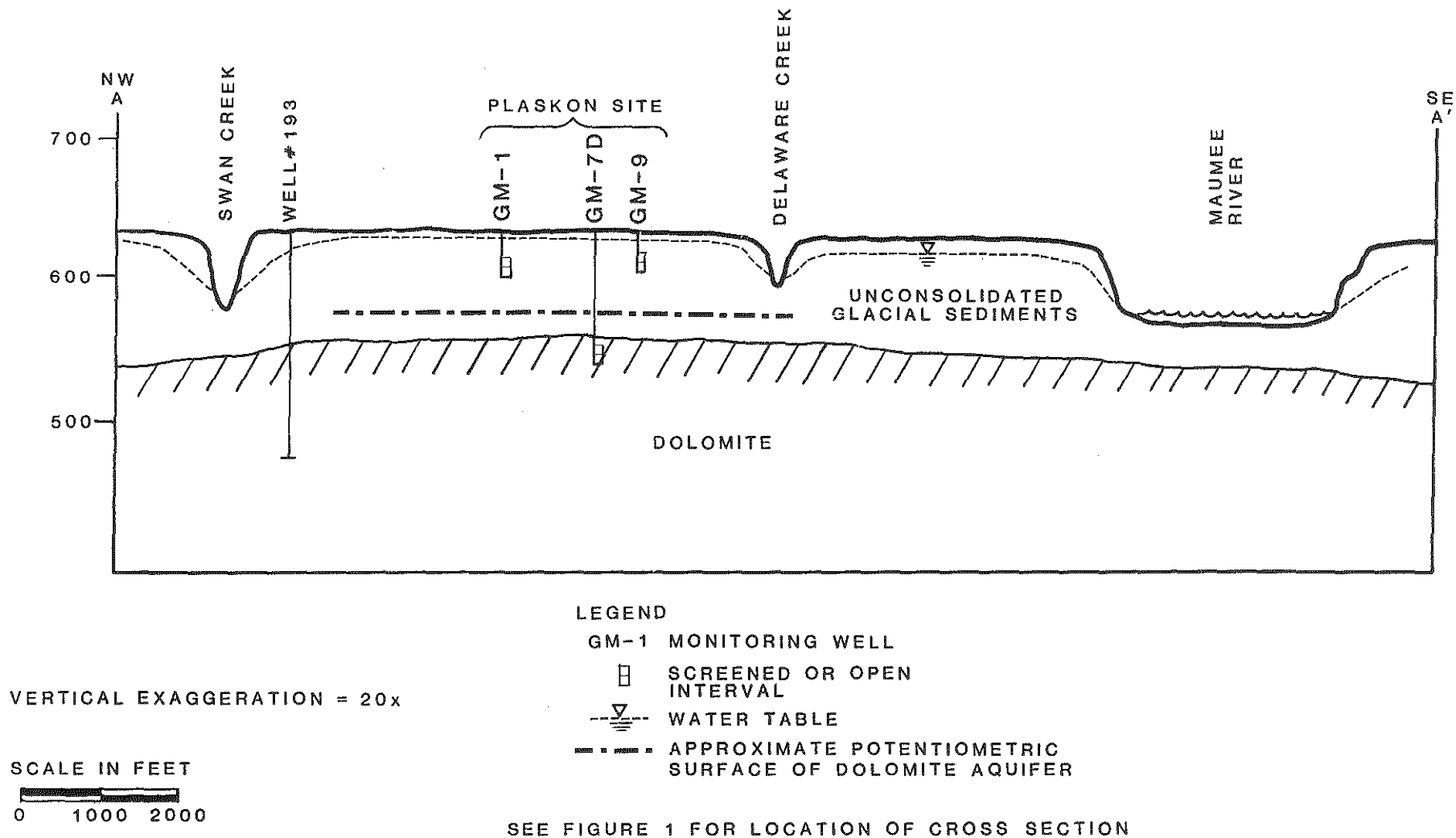
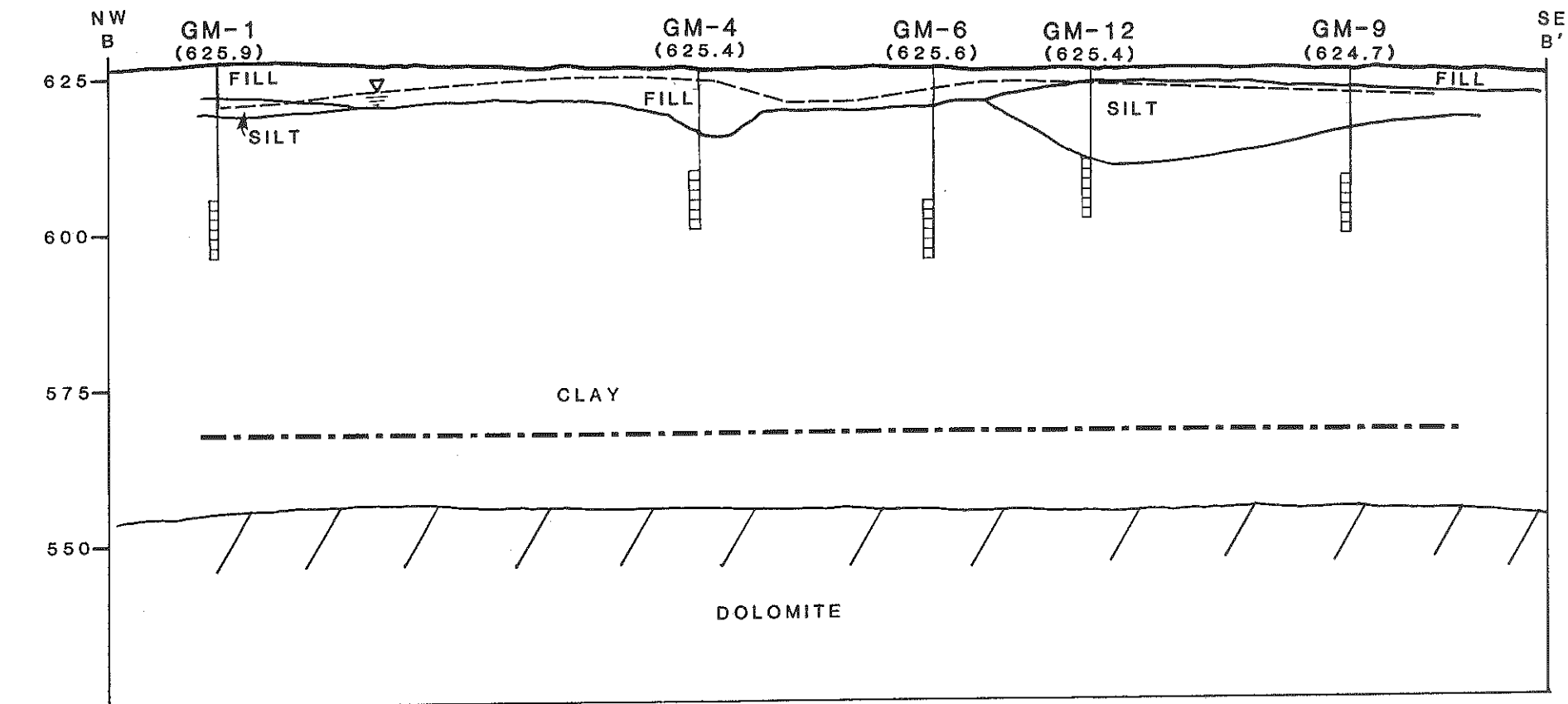


FIGURE 8
VERTICAL HEAD LOSS AND
VERTICAL HYDRAULIC GRADIENT
THROUGH GLACIAL DRIFT, 1970.
(FROM KUNKLE, 1971)





VERTICAL EXAGGERATION = 4x

0 50 100
SCALE IN FEET

LEGEND

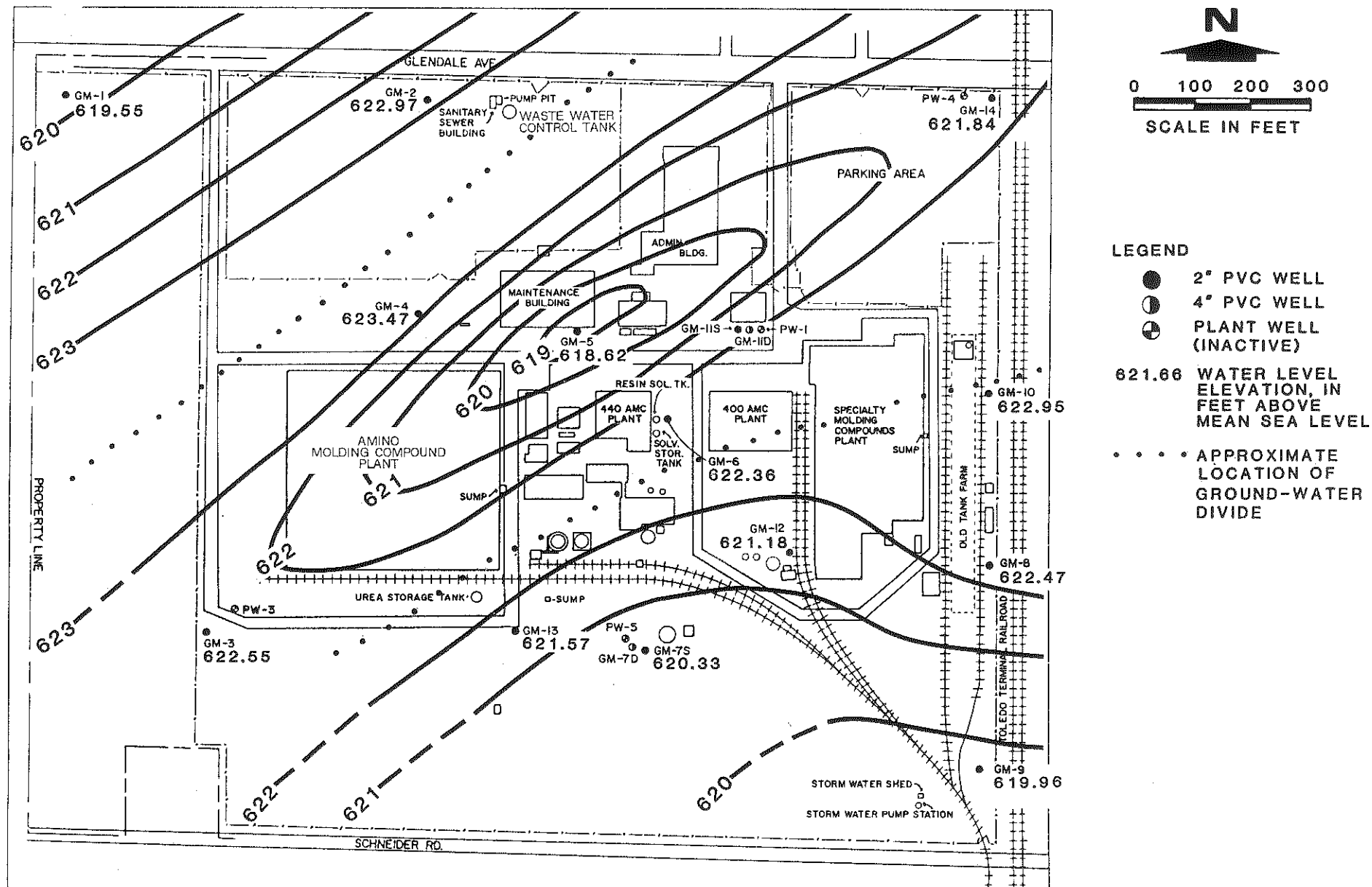
- GM-1 MONITORING WELL
- (625.9) LAND SURFACE ELEVATION (FEET MSL)
- POTENTIOMETRIC SURFACE OF DOLOMITE
- WATER TABLE
- SCREENED INTERVAL

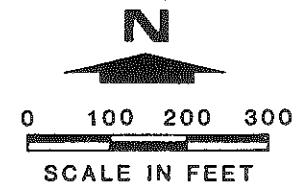
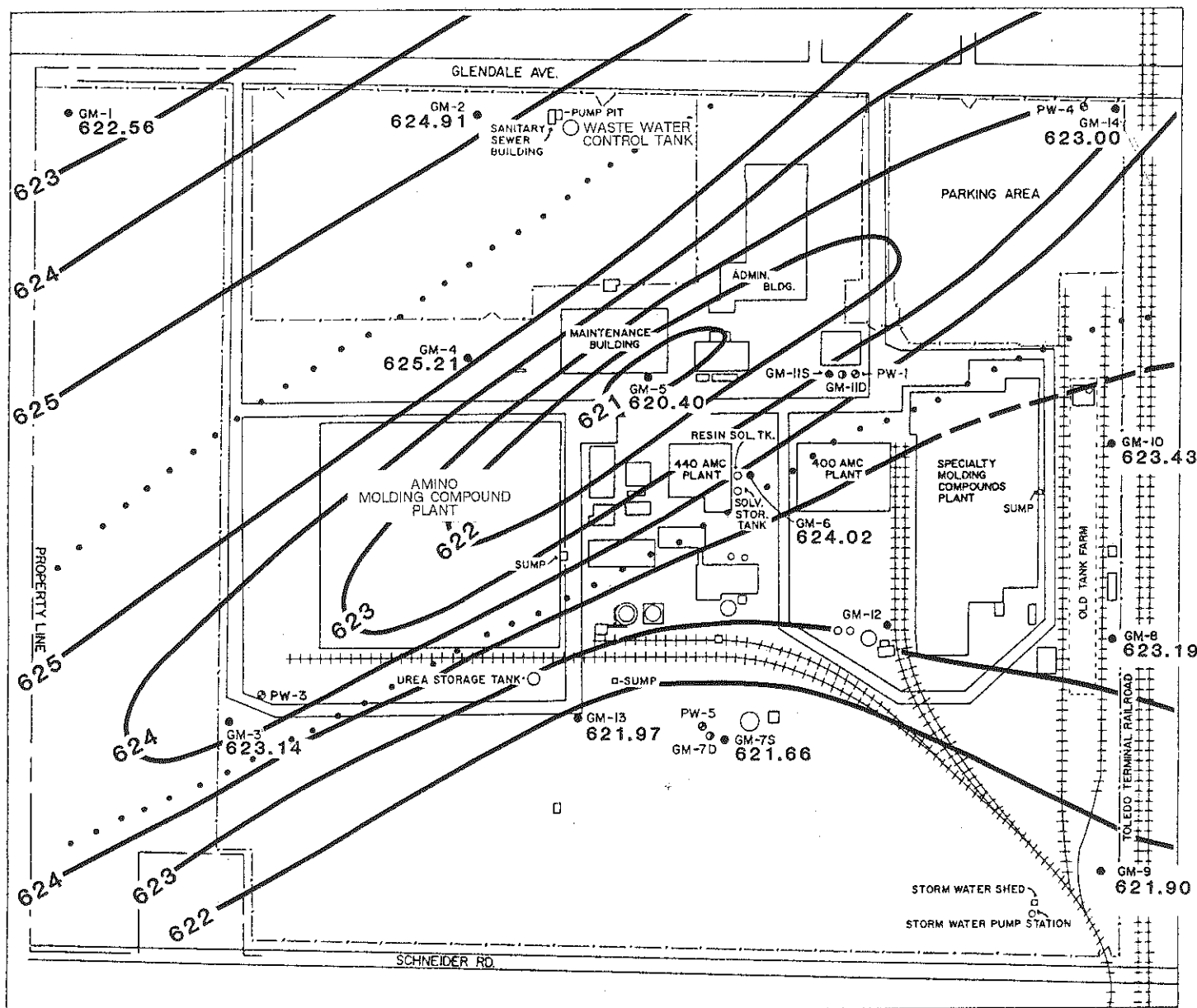
- FILL - SILT, SAND AND CLAY
CONTAINS SOME GRAVEL
- SILT - CONTAINS SOME CLAY
AND TRACES OF SAND
- CLAY - CONTAINS SOME SILT
TRACES OF SAND AND GRAVEL



SEE FIGURE 2 FOR LOCATION OF CROSS SECTION

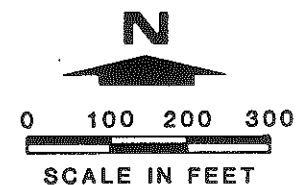
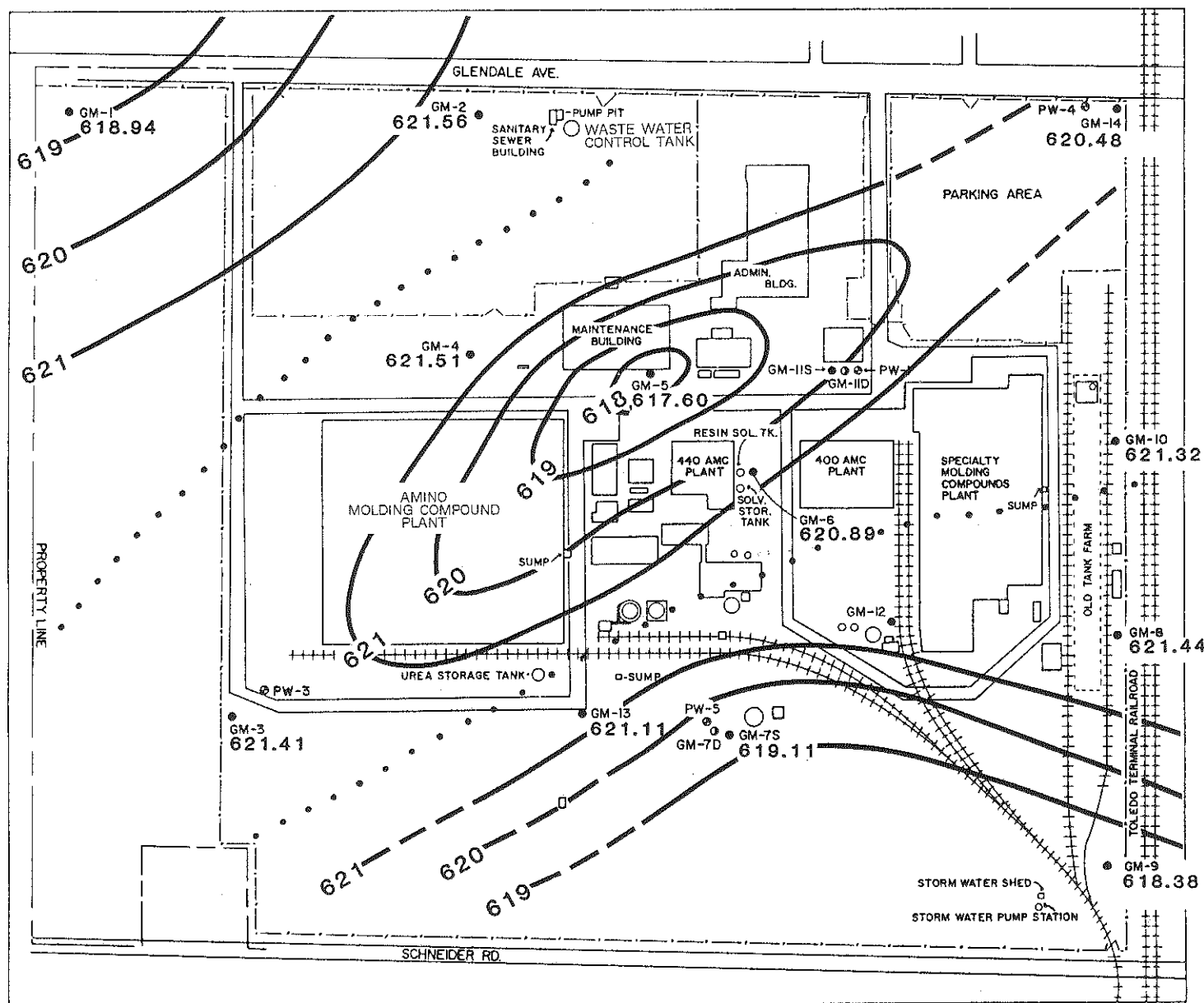
FIGURE 10
GEOLOGIC CROSS SECTION
OF PLASKON SITE





- LEGEND**
- 2" PVC WELL
 - 4" PVC WELL
 - ⊙ PLANT WELL (INACTIVE)
 - 621.66 WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
 - ... APPROXIMATE LOCATION OF GROUND-WATER DIVIDE

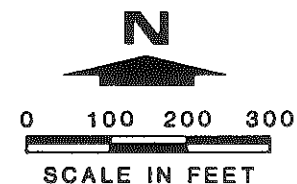
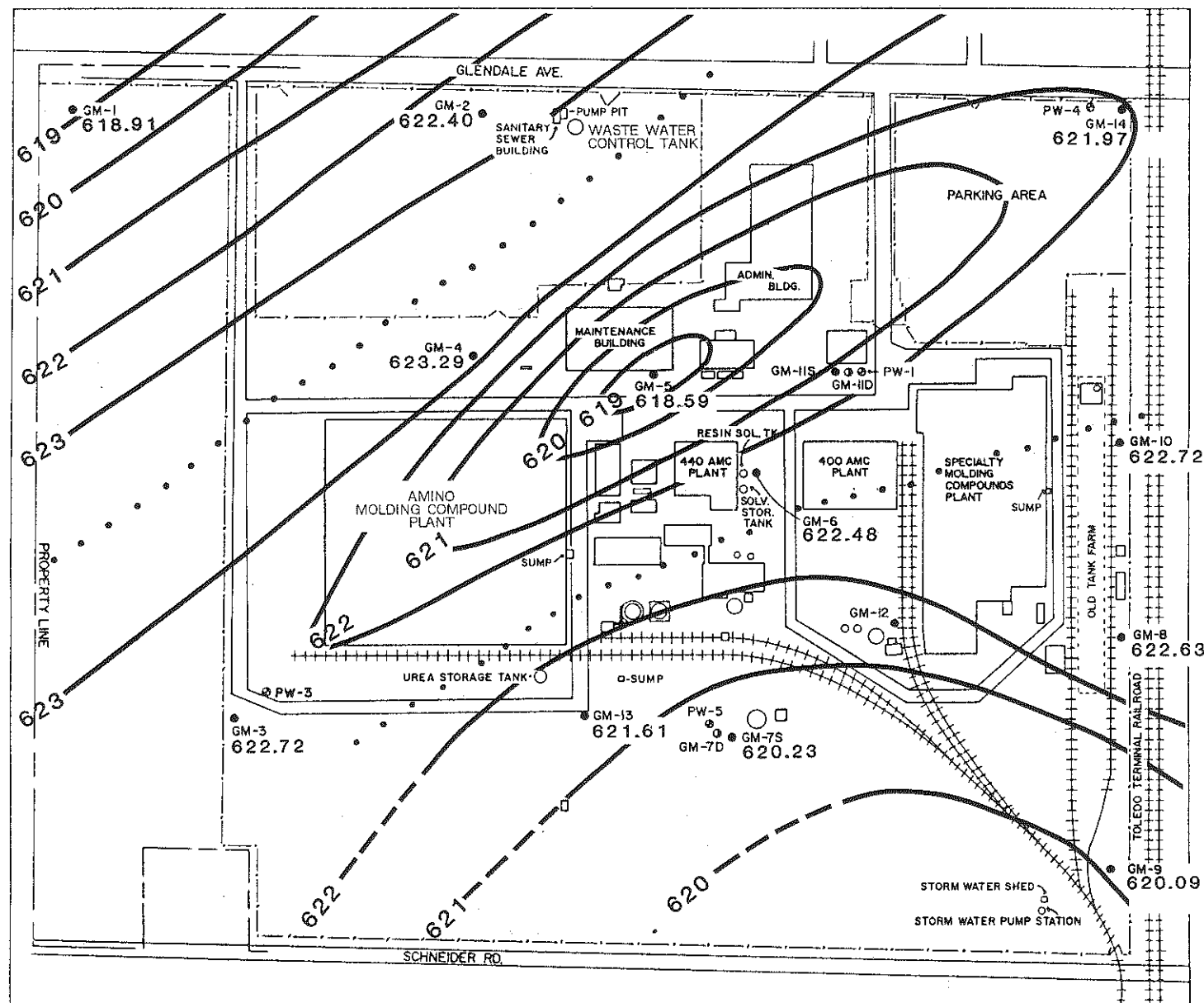
FIGURE 12
CONFIGURATION OF
THE WATER TABLE
OCTOBER 4, 1986



LEGEND

- 2" PVC WELL
- ◐ 4" PVC WELL
- ⊗ PLANT WELL (INACTIVE)
- 621.66 WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- ... APPROXIMATE LOCATION OF GROUND-WATER DIVIDE

FIGURE 13
CONFIGURATION OF
THE WATER TABLE
NOVEMBER 17, 1986



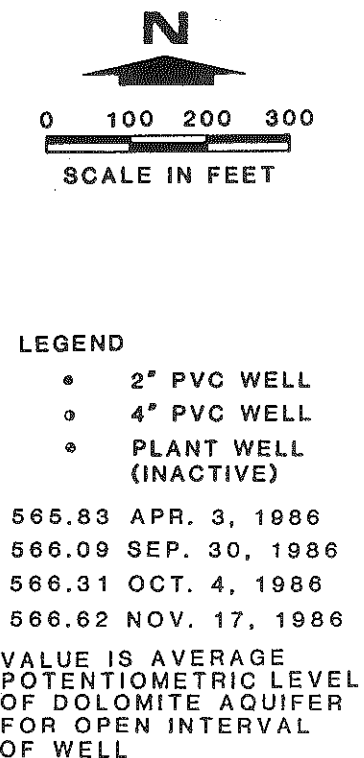
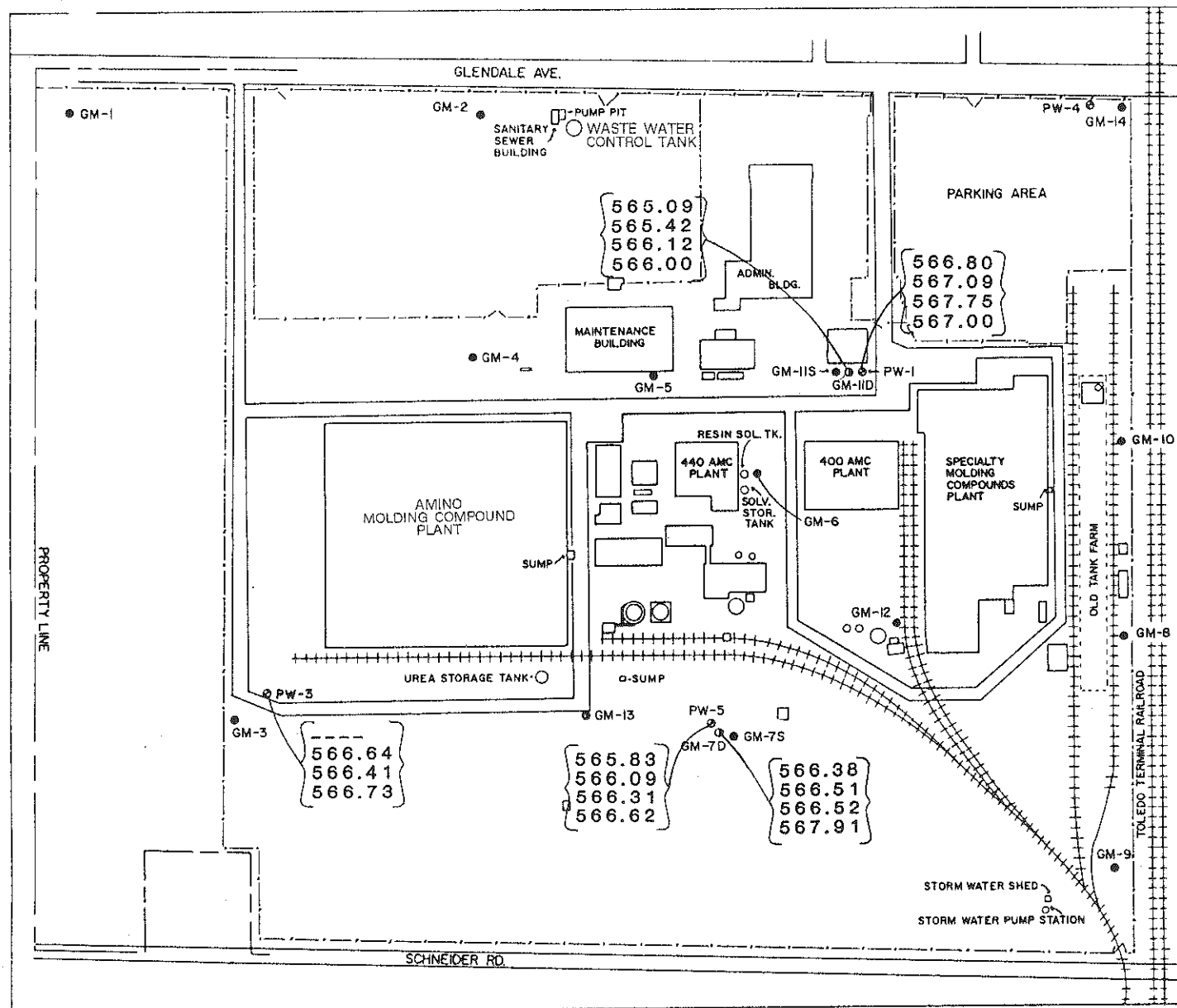
LEGEND

- 2" PVC WELL
- 4" PVC WELL
- ⊗ PLANT WELL (INACTIVE)

621.66 WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL

..... APPROXIMATE LOCATION OF GROUND-WATER DIVIDE

NOTE:
GM-11S FOR LOCATION ONLY - ABANDONED 4-2-86



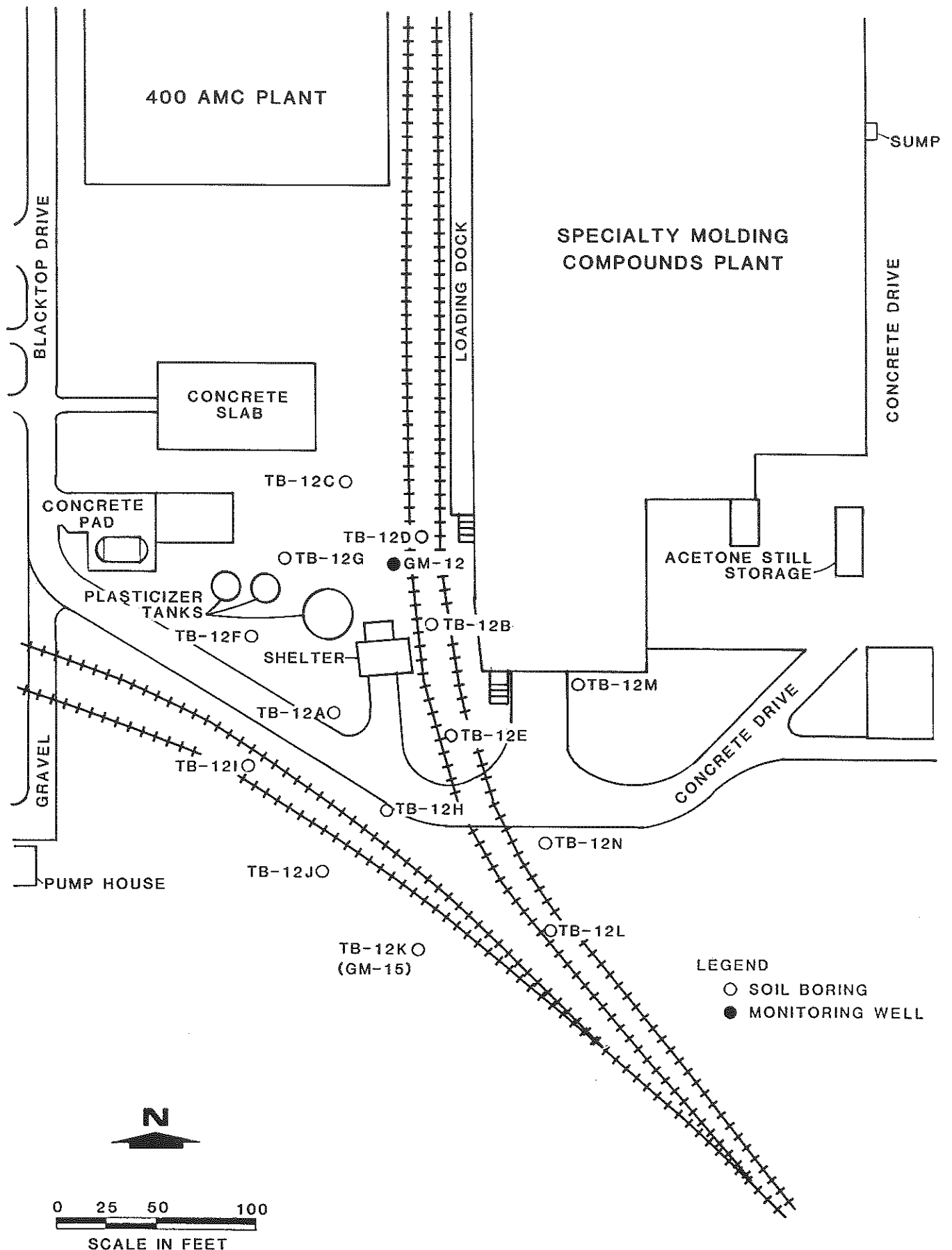


FIGURE 16
SOIL BORING LOCATIONS
IN THE VICINITY OF
THE PLASTICIZER TANK FARM

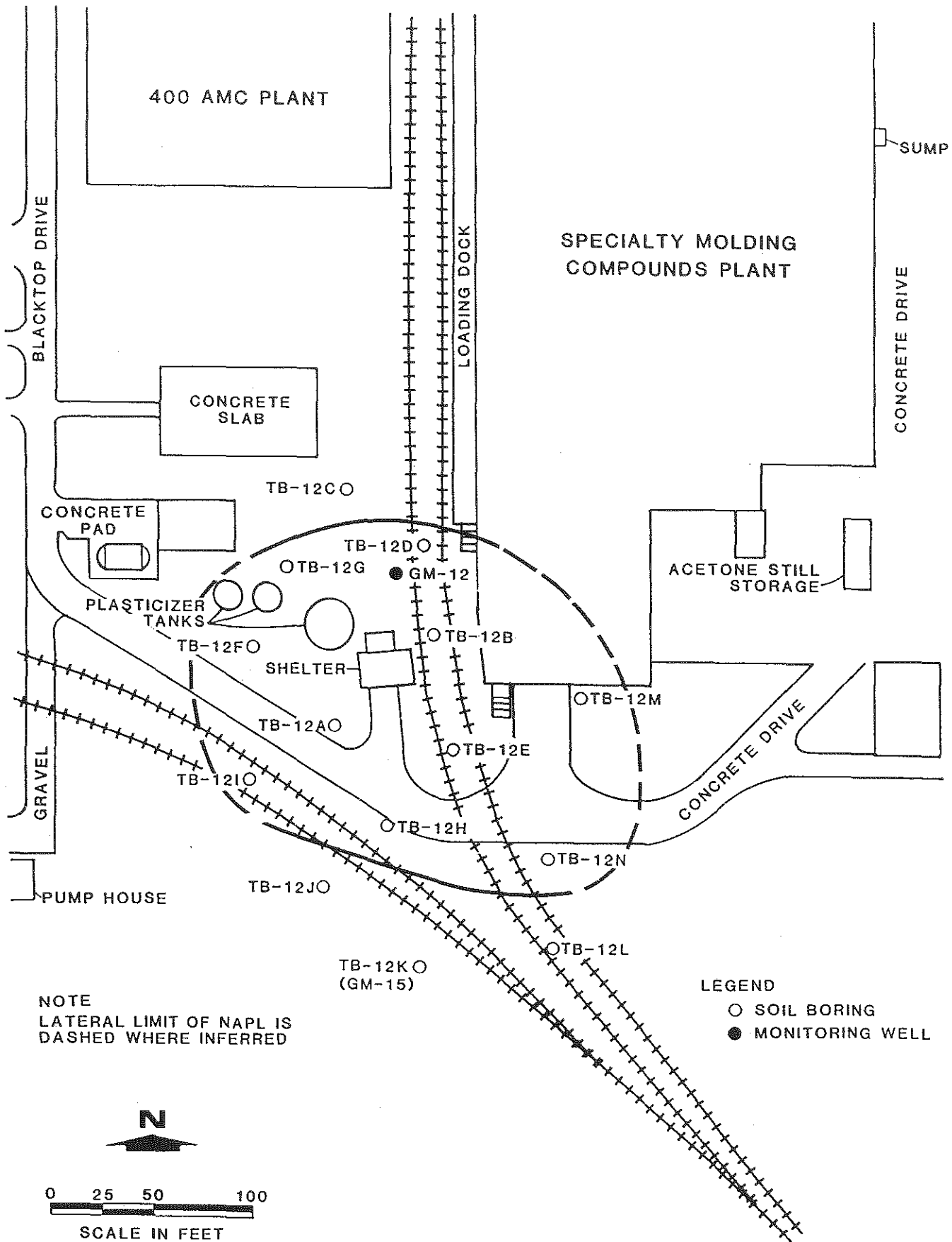


FIGURE 17
AREAL EXTENT OF OBSERVED NAPL
FEBRUARY 12, 1987

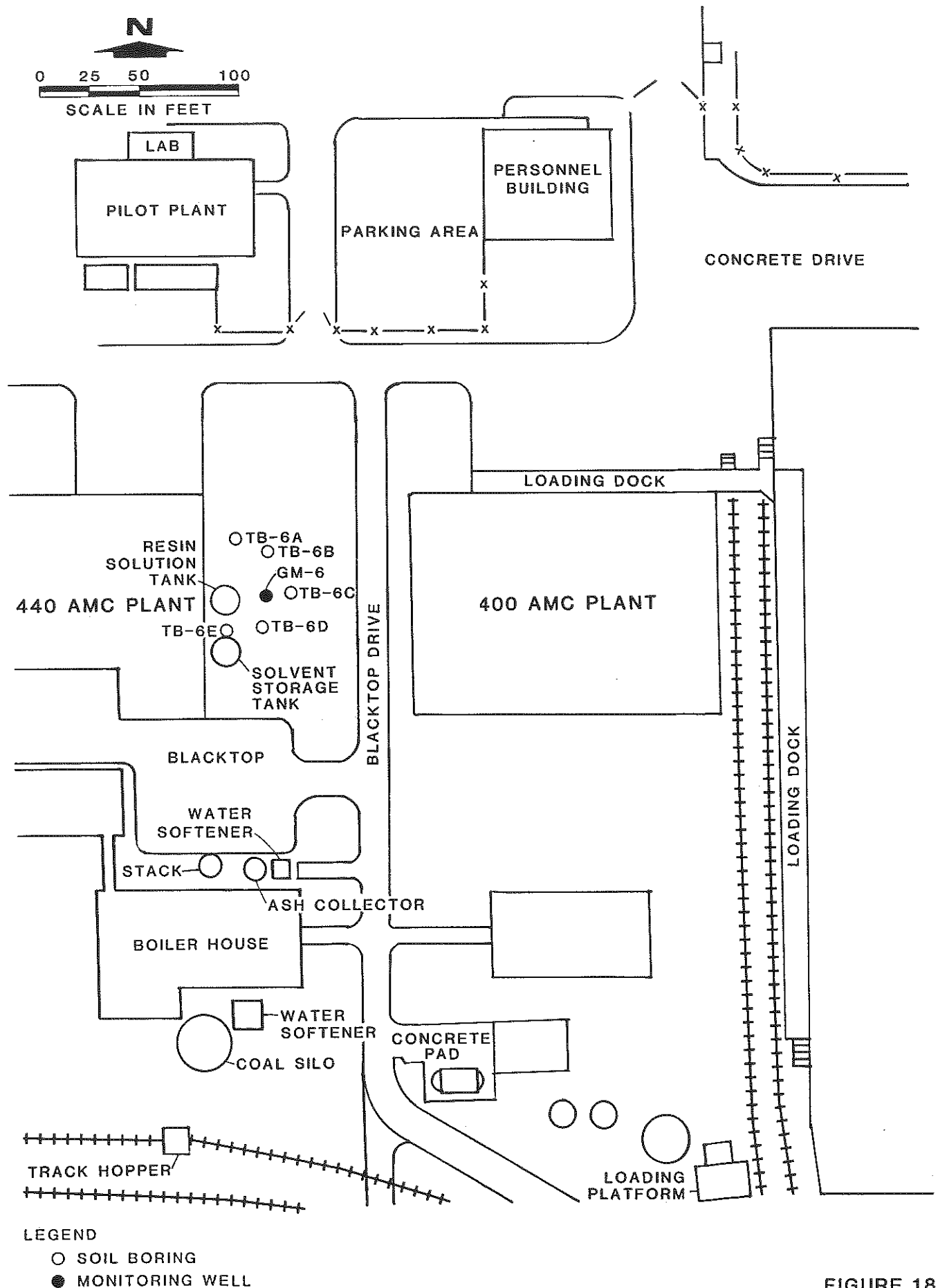


FIGURE 18
SOIL BORING LOCATIONS
IN THE VICINITY OF
THE METHYLENE CHLORIDE TANK



FIGURE 19
SEWER SYSTEM CONFIGURATION
NEAR PLASTICIZER TANK FARM